Analysis of Video Records of Sea Floor Features Collected by Remotely Operated Vehicle Along the Proposed Islander East Gas Pipeline Corridor in Long Island Sound

Prepared by:
Roman N. Zajac, Ph.D.

August 21, 2002

Introduction:

A video survey of the sea floor along the proposed Islander East gas pipeline corridor in Long Island Sound (LIS) was conducted using a remotely operated vehicle (ROV) in order to better understand the ecological characteristics of the benthic habitats and communities along the corridor. ROV surveys are effective in providing information that generally cannot be obtained by grab sampling, such as information on habitat structure and community composition over larger, and continuous, areas than the grab samples, fragile features which might be destroyed by grab sampling, and fauna and flora not sampled by bottom grabs. In conjunction with other types of data, e.g. bottom grabs, side scan images and photographs, they provide a more complete depiction of benthic habitats and communities in a given area.

Methods:

The survey was conducted between April 29 and May 19, 2002 by Ocean Surveys, Inc., (OSI) using a Phantom HD 2+2 ROV equipped with a video camera. Continuous video data was recorded on VHS tapes, along with real time positioning collected using a global positioning system (GPS). The ROV was also equipped with laser scaling which generates two dots on the sea floor a constant 4 inches apart, and these are visible on the video records. Details on equipment and field survey operations as provided by OSI are given in Appendix 1.

The survey design (Figure 1) was comprised of 10 east to west, lateral, survey lines in Connecticut nearshore waters (Lines 2 - 11), 8 east to west lines in New York nearshore waters (Lines 12 - 19), and one line spanning the entire central axis of the pipeline corridor from the HDD exit area to Long Island (Line 1). The lateral lines averaged ~ 2,956 feet in length, corresponding to the potential width of the overall pipeline corridor, and ROV running time averaged 40 minutes per lateral line. Along each lateral line, 5 video segments of 2 minutes duration each were analyzed to obtain data on video features. Each 2 minute segment was ~ 148 ft in length. Start and end coordinates of each line are given in Appendix 1.

Prior to collecting the data from the video tapes, several tape segments from nearshore and deepwater areas were reviewed in order to develop a list of general features that could be seen and quantified on the tapes. Based on this review, 8 categories of features were established (Table 1) for which data could be reasonably collected from the video records. Most of the categories comprise several types of specific, but similar, features. This analysis is meant to

provide information on the relative levels of occurrence of these feature types along the pipeline corridor, and the presence/ absence of specific features associated with the sea floor. Information on the presence of large epifauna (lobsters, crabs, flatfish) and other features not included in the 8 categories selected for analysis was also noted during data collection from the video records.

Data was collected along each line by first reviewing tape from the entire line (or sections of Line 1 between consecutive mileposts) to note general changes in sea floor characteristics along the whole line and then the 2 minute segments of the video tape were scored for the 8 categories at roughly equally spaced intervals along the line. Each two minute segment was replayed as many times as necessary to obtain counts of the 8 categories of sea floor features. Data collection was aided by the use of a mechanical counter. Any category features that were present within the swath defined by the two laser points on the sediment or touching the points were counted.

Results:

Sea floor characteristics along each lateral line and the deepwater center- line are described first, followed by an overall summary of larger-scale changes in sea floor features in the pipeline corridor. Note that in all cases, the geographic sequence of data shown in the graphs follow standard conventions with north and south at the top and bottom of the page, respectively, and east and west to the right and left of the page, respectively. Also, some line sections have six 2 minute video samples, and some have four. These differences are due to variations in the length of the survey lines as determined by distance and the speed of the ROV. In a few cases, good imagery was not available to perform a 2 minute quantitative data along certain line sections. Below each graph is a plot showing the actual survey line as recorded by GPS. For lateral lines, arrows point to approximate positions of two minute sections that were analyzed; for Line #1 (i.e the pipeline center line spanning Long Island Sound) corresponding survey line locations of each segment are shown by numbers.

This document involves pipeline location information and is not available at this Internet site due to homeland security-related considerations. This portion of the Islander East consistency appeal administrative record may be reviewed at NOAA's Office of General Counsel for Ocean Services, 1305 East-West Highway, Silver Spring, Maryland.

Table 1. Sea floor features and their characteristics that were enumerated on video records of the proposed Islander East pipeline corridor.

Category	Description
Algae:	Macroalgae (various species), either attached to shells, cobbles of some other hard substrate, or free drifting. If the algae were attached to shells the video was reviewed several times to determine if the shells appeared to be live individuals of either mussels or oysters. If they were, then these algae were included in the bivalve clump count. Most Bivalve clumps had attached algae.
Bivalve Clumps:	Bivalve clumps included aggregations of either mussels (*Mytilus edulis*) or oysters (*Crassostrea virginica*). Most of these clumps were small, comprised of approximately 2 to 5 individuals for oysters, and 2 to 10 individuals for mussels. More extensive mussel beds are noted in the line descriptions given in the results.
Pits, Mounds, Burrows (PMB):	This category is comprised of several features that often co-occur. Burrows (cave-like structures, or deep tubes) and pits (shallow depressions in the sediment with no obvious cave-like excavation of the sediment) often have associated with them mounds which are the excavated sediment. Burrows and pits are created by a variety of fauna in Long Island Sound including lobsters (*Homarus americanus*), crabs, some fish, and deep burrowing crustaceans such as the mantis shrimp, *Squilla empusa*.
Tracks:	This category include trails made primarily by gastropods, but also included furrows in the sediment that may have been created by trawling activities and anchor drags. Tracks created by large crustaceans such as crabs and lobsters were also noted.
Tubes:	This category included tubes of various sizes that are primarily created by polychaetes and amphipod crustaceans, and erect fauna that could be distinguished on the video records. Some areas were characterized by individual tubes, but in other areas the tubes occurred as both clusters and as solitary, easily distinguished features. Clusters of tubes were counted as one individual feature, as the resolution and speed of the tape did not allow for counting the number of tubes in the clusters. The erect fauna included the burrowing anenome *Ceriantheopsis americana* and the hydrozoan *Corymorpha pendula.*

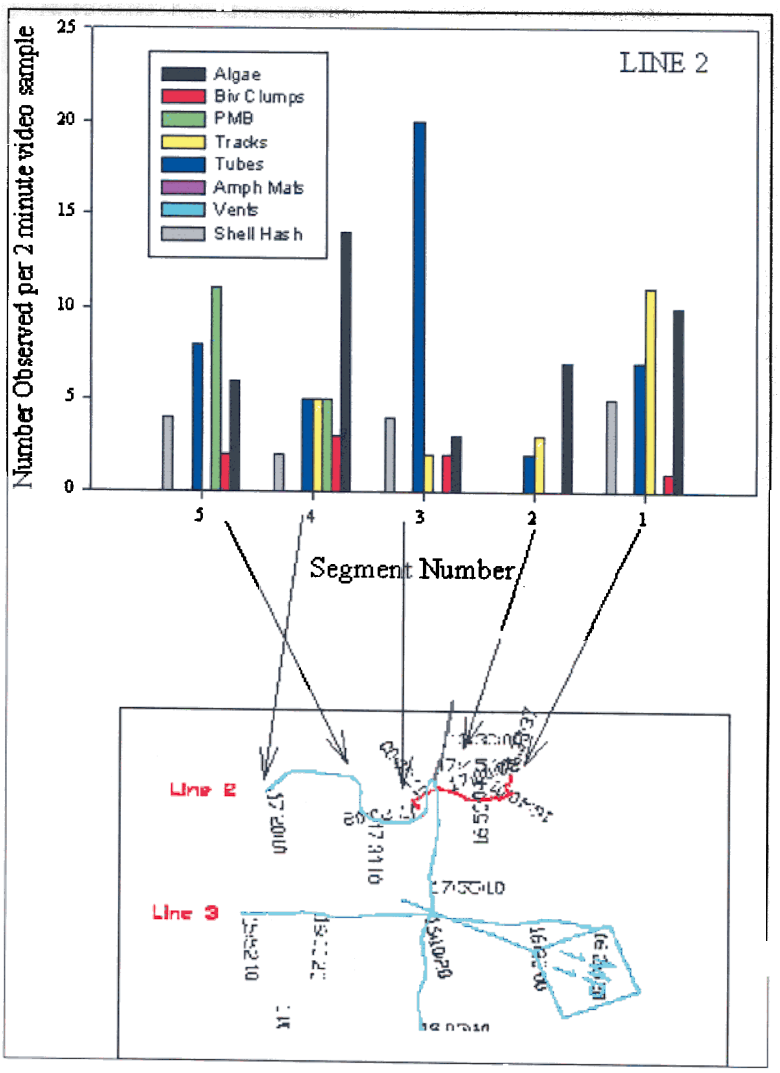
Table - continued

Amphipod Mats:	Several species of amphipods in Long Island Sound, notably of the genus *Ampelisca*, create dense aggregations of tubes commonly referred to as amphipod mats. These are quite distinct, generally have a mounded structure and can be relatively large (~ 1 m^2 in area or more).
Vents:	Vents are comprised of venting events that were seen as the ROV flew over the sea floor. Specifically these are the exhalation of water and sediment by bivalves (via their exhalent siphons) and by other fauna from within their burrows.
Shell Hash:	Shell hash comprises concentrations of dead shell material on the sea floor. Shell hash area was counted if the shell hash completely covered the swath between the laser pointers. Continuous belts of shell were enumerated by adding one to the count every 10 seconds of the continuous area.

Connecticut Nearshore Lateral Survey Lines

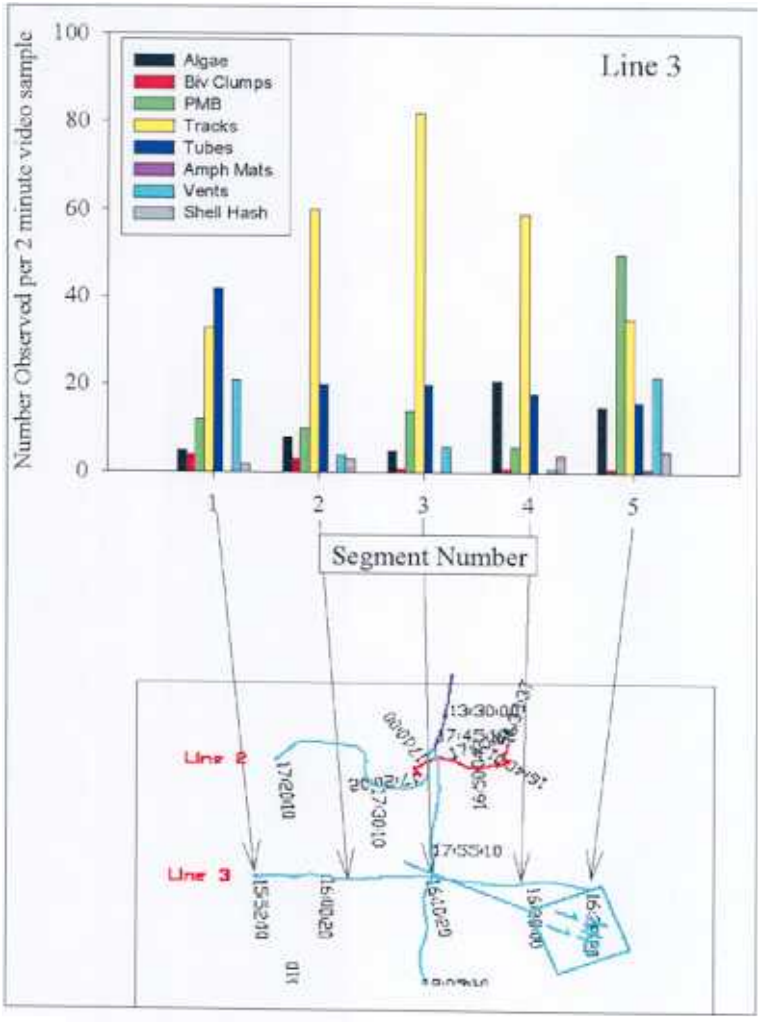
Line 2.

Line 2, located close to the Connecticut shore, just north of Milepost (MP) 11, was characterized by a diversity of sea floor features. Algae were found within each segment. Bivalve clumps were found in 4 of the 5 segments, as was shell hash. The bivalve clumps were all mussels, except for one oyster clump. Tubes were the most common feature at the center of the segment, coinciding with the centerline of the pipeline corridor. Most of the tube category was comprised of the burrowing anemone *Ceriantheopsis americana* and unidentified polychaete tubes. Relatively more features were found in the western position of the line than in the east. Overall, the habitat was a soft, bioturbated, mud along the whole length of the line, with some rocks at the eastern end of the line. The rocks supported a fouling community comprised of algae, hydroids and sponges. The rocks were also heavily silted. Algae found along the line consisted of green and brown filamentous varieties.



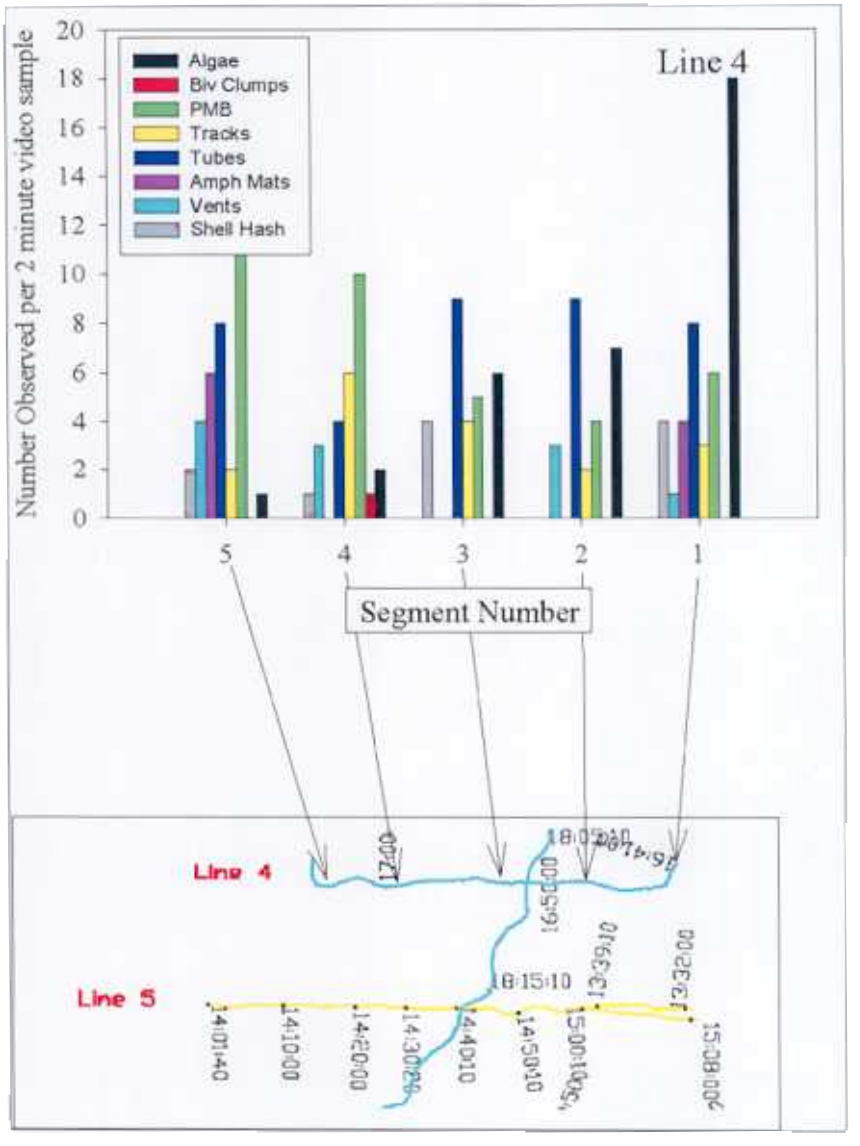
Line 3

Line 3, located at MP 11 was characterized by soft muds with many tracks, small pits and burrows, and tubes. The tracks were primarily made by snails, but also by crabs. Most of the tubes were polychaete tubes, there were a few burrowing anemones. Bivalve clumps (mussels) were found across the entire line but mostly to the west of the centerline. Relatively high numbers of venting events in segments 1 and 5 suggest increased numbers of larger infauna at the westerns and eastern ends of the line (likely bivalves and perhaps burrowing crustaceans). The amount of algae increase in the eastern end of the line, and there was one large amphipod mat observed at the eastern end as well, in Segment 5.



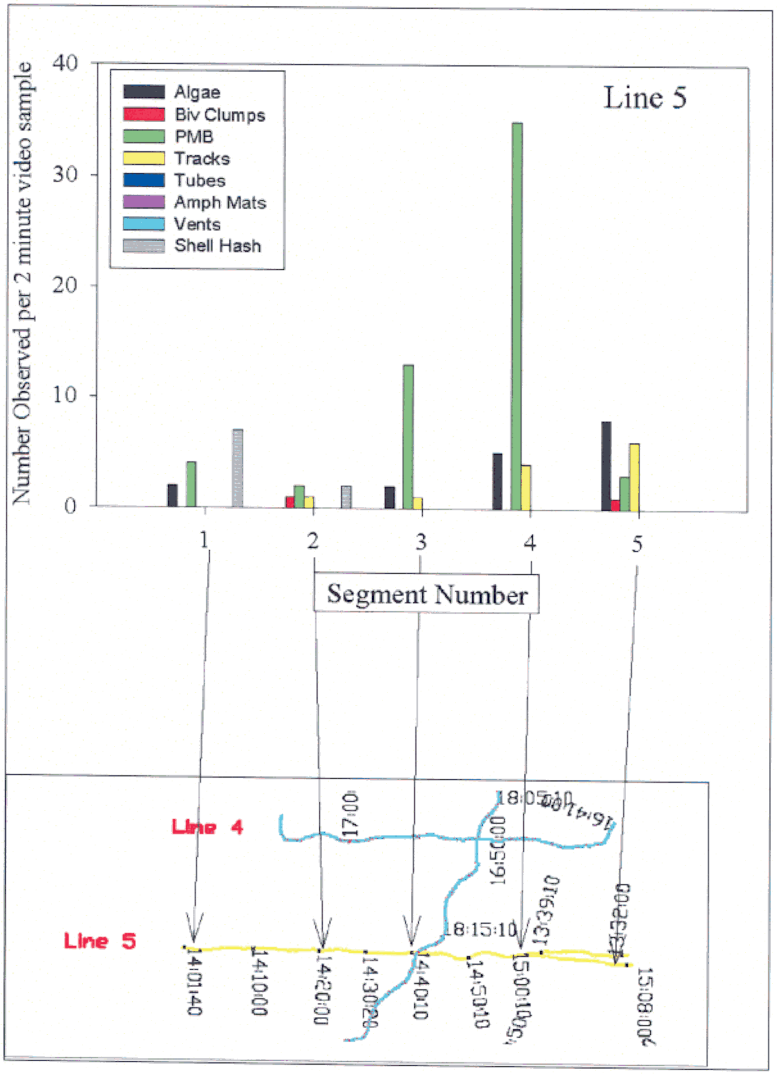
Line 4

The portion of the pipeline corridor traversed by Line 4 included a variety of features. Tubes and pits, mounds and burrows were found relatively frequently along all portions of the line. Algae was abundant on the eastern end of the line, and steadily decreased to the west. Extensive amphipod mats were found at both ends of the line (Segments 1 and 5). The shell hash present was comprised primarily of small *Mulinia lateralis* shells. The surface of the sediment along the line was easily disturbed by the ROV indicating the presence of soft muds. No bivalve clumps were observed and relatively few venting events.



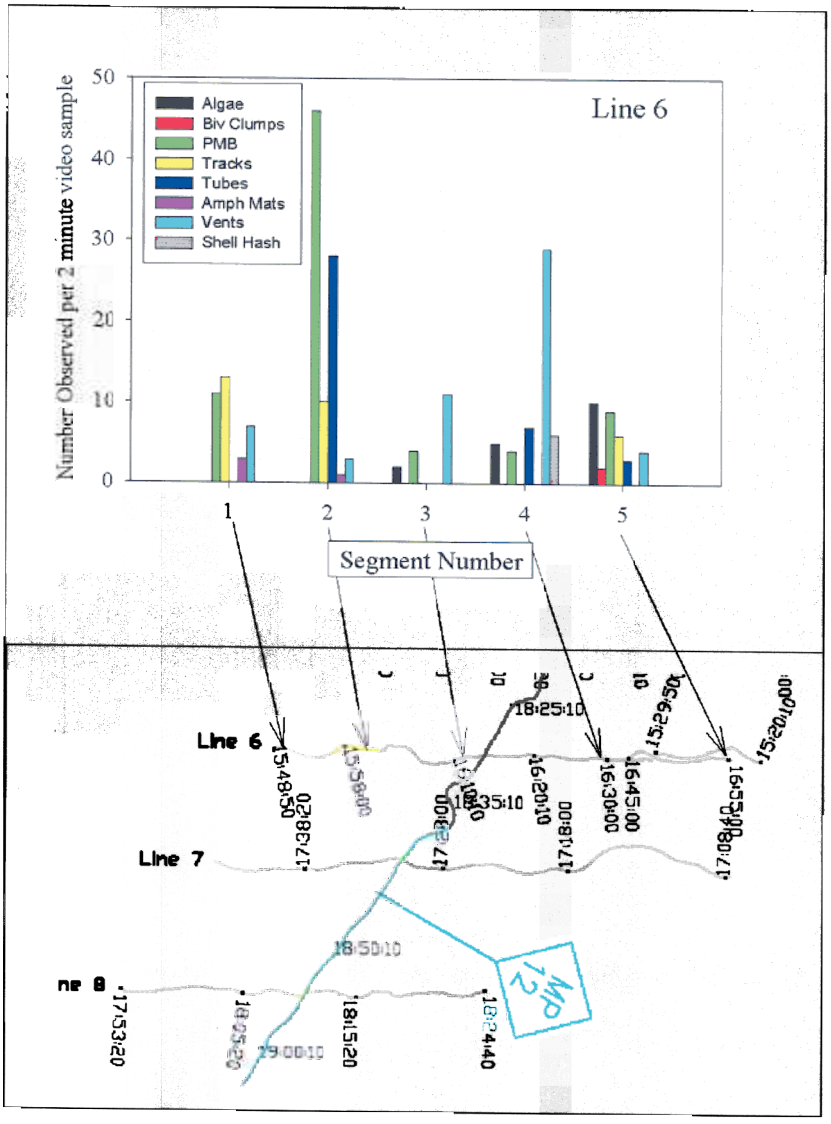
Line 5

Compared to the other lateral lines, Line 5 was characterized by relatively few features. Pit, mounds and burrows were the most prevalent features, particularly in Segment 4 in the eastern end of the line. Other features, including algae and tracks, were also more abundant on the eastern side of the line. There appeared to be a rise at this end of the line. The tracks in segment 5 appeared to be man-made, perhaps anchor drag scars. The algae included filamentous greens and browns, and also some strands of *Laminaria*. On the western end of Line 5 there was an abundance of shell hash, mainly *Mulinia* shells, but also some hard clam (*Mercenaria mercenaria*) shells. There were several small clumps of oysters along this end of the line as well. Sediments along the line were primarily muds, except where shell hash was found.



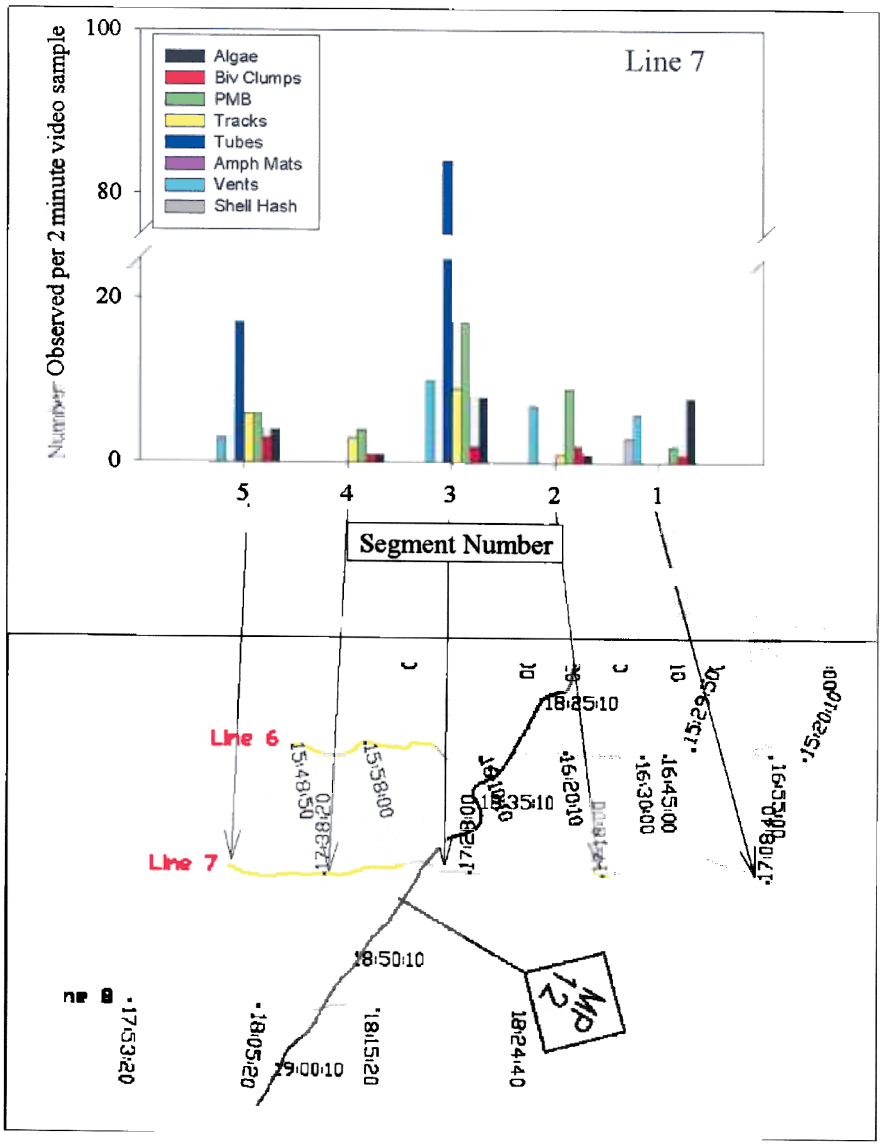
Line 6

Moving from west to east, Line 6 was characterized by mostly featureless muds, to muds mixed with some shell hash just before Segment 2. Several amphipod mats were found in the area of Segment 1. In the area of Segment 2, there large numbers of tubes, which looked like those constructed by maldanid polychaetes. The center of the line, spanning the proposed pipeline centerline had relatively few features. The most evident feature was venting, indicating the presence of clams and/or burrowing crustaceans. Venting events increased in number through Segment 4 and declined at the eastern end of the line. The sediments also appeared to be sandier along the western end of the line, past the centerpoint (~ Segment 3). Several clumps of mussels were found in Segment 5. Algae was only found along the eastern portion of the line.



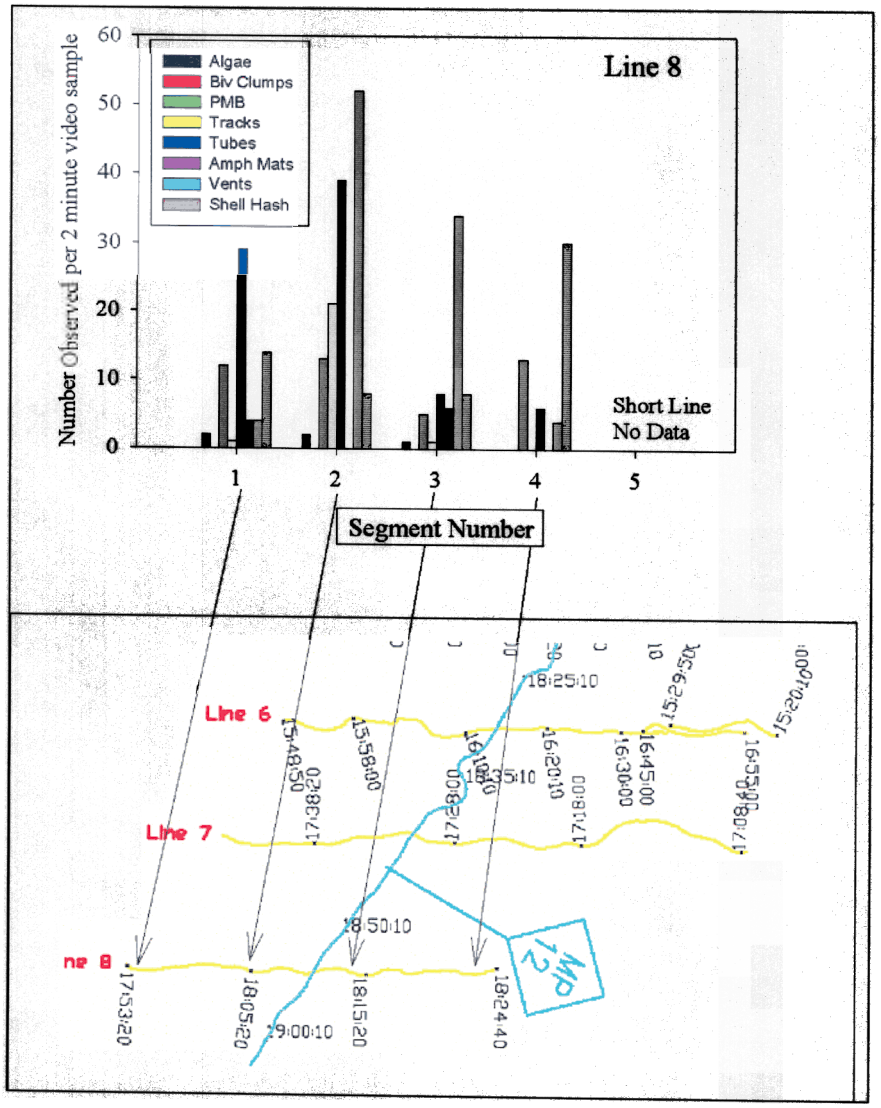
Line 7

Line 7 was located just north of MP 12. Clumps of mussel, and a few clumps of oysters were found within each segment analyzed. The muddy sea floor was moderately bioturbated along the whole line as evidences by the pits, mounds and burrows . The most features were observed in the middle of the line, along Segment 3. Tubes were particularly abundant. The tubes were of assorted sizes, suggesting several species of tubiculous infauna were occupying this area. The tubes looked to be primarily constructed by polychaetes. A moderate number of venting events were observed along all segments except Segment 4. Several flounder were observed along the line as well.



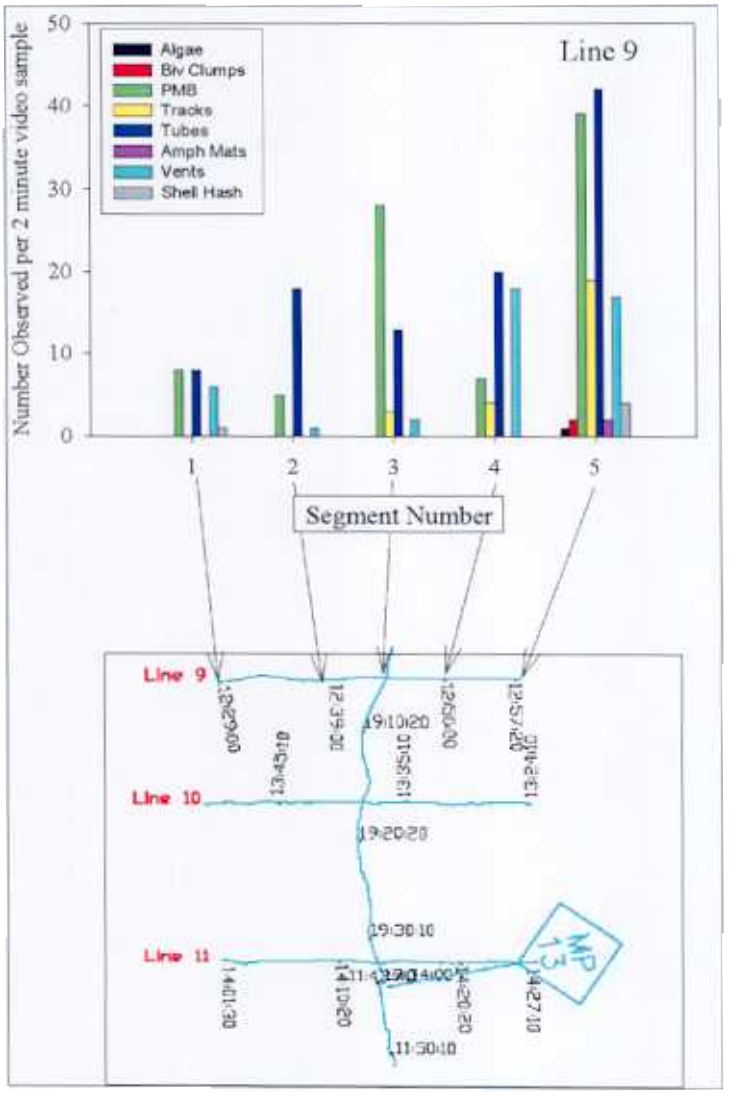
Line 8

Only four segments were analyzed along Line 8 because it was a short line relative to the available video records and segment spacing. The western end of the line was comprised of tubes and several tube mats. There was also a fair amount of shell hash (primarily *Mulinia*). There was a small rock outcrop between Segments 1 and 2. Along Segment 2, the number of tubes increased and there was a sharp increase in the number of venting events. A large number of tracks also indicates a biotically active area. Several large amphipod tube mats were found along Segment 3, the numbers of venting was still high but declined somewhat relative to Segment 2. The most prominent feature along segment 4 was shell hash, with *Mulinia* shells blanketing most of the bottom.



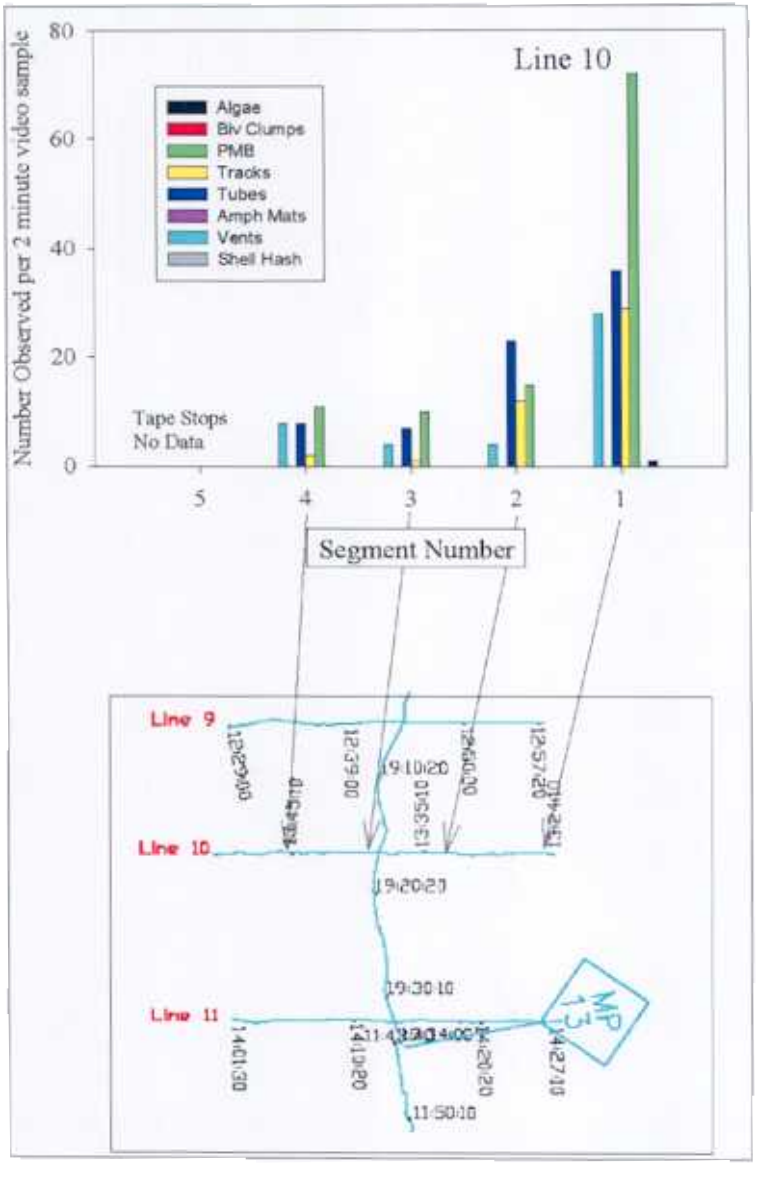
Line 9

Line 9 was comprised of a mud bottom with increasing numbers of surface features from west to east. The most abundant features across the entire line were tubes and pits, mounds and burrows. Few tracks were evident along Segments 3 and 4, but these increased along segment 5. The most features were found at the eastern end of the line, along Segment 5, and included some algae, several mussel clumps, and several amphipod mats. High number of venting events were found along segments 4 and 5. At the very end of the line, just past Segment 5, was a rock outcrop with a large mussel bed, and many burrows just before the outcrop.



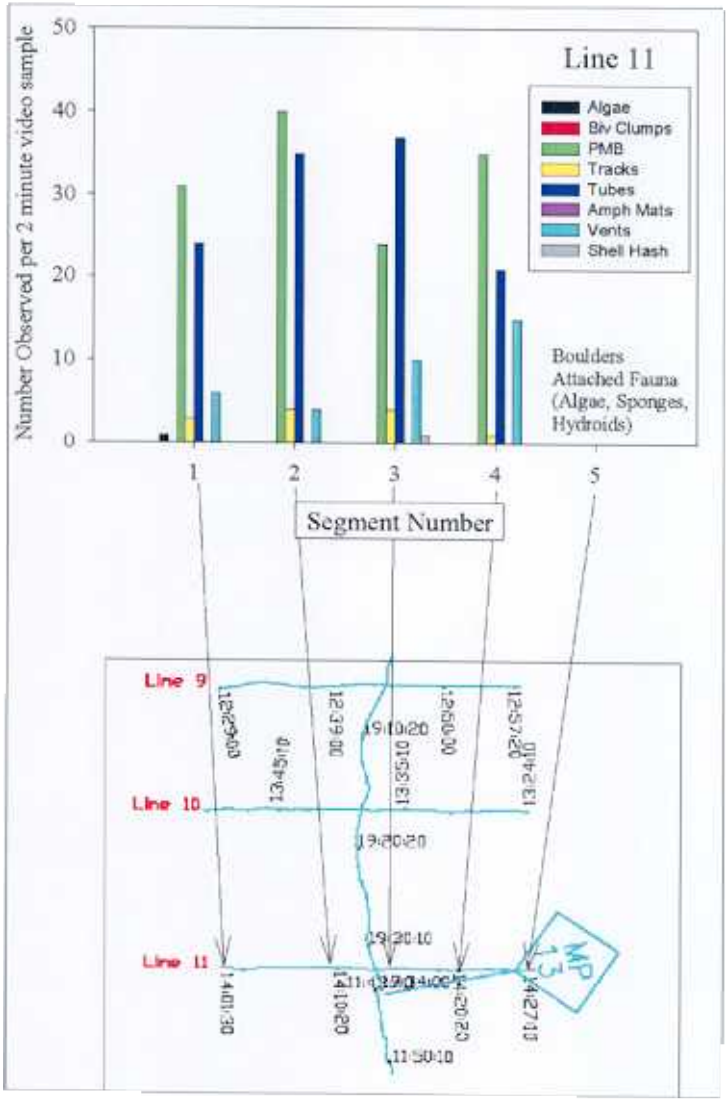
Line 10

The eastern end of Line 10 was heavily bioturbated mud with some relatively large burrows between and within Segments 1 and 2. The largest number of features were found along Segment 1. There was a high number of pits, mound and burrows, as well as tubes, tracks and venting events. All of these features decreased moving west from Segment 1. Relatively low numbers of features were found along Segments 3 and 4. No data was available for the western end of the line due to cessation of recording.



Line 11.

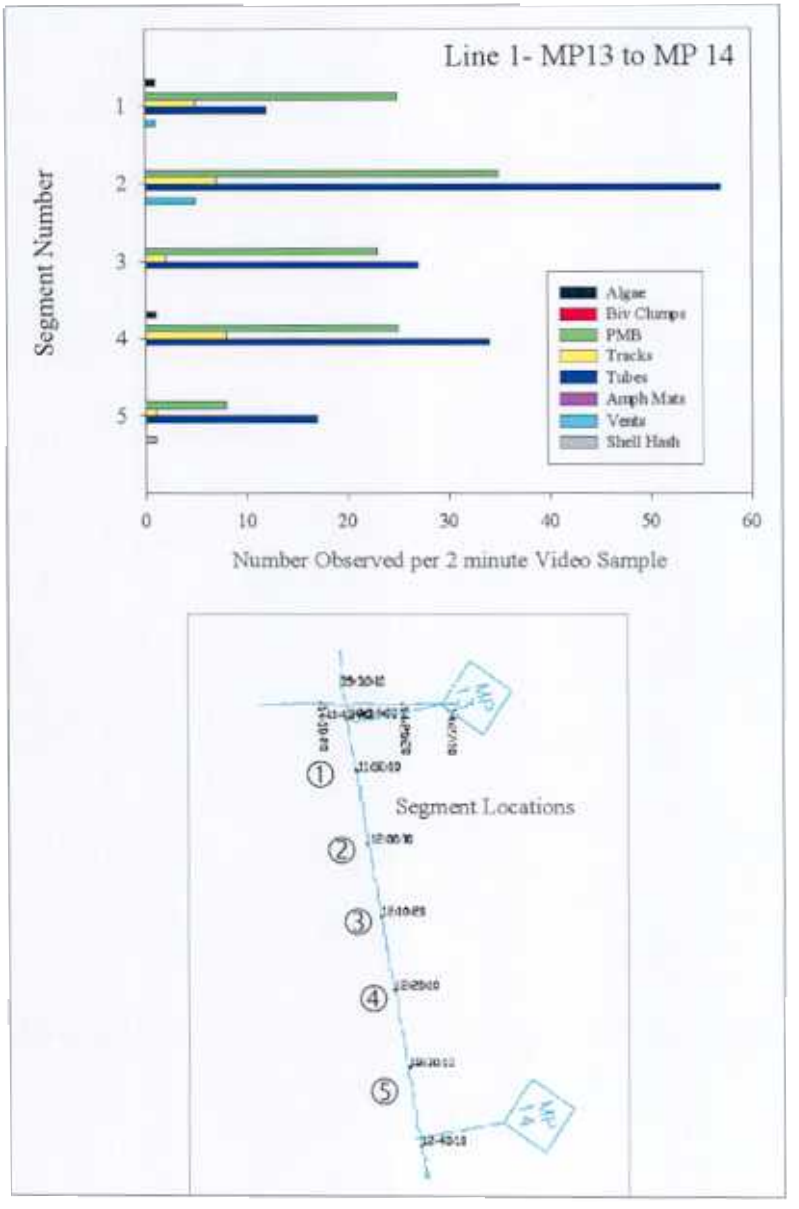
Line 11 was the last lateral line surveyed in nearshore Connecticut waters and was located just north of MP 13. The line was characterized by bioturbated muds between the western end of the line and Segment 4. At the eastern end of the line was a rock/boulder area. The rocks were fairly well sedimented, but supported a hard substrate community of algae, sponges and hydroids. Mussel beds were also found in the rock area. The mud portions of the line (Segments 1 - 4) had a similar number of tubes, pits, mounds and burrows throughout. Moderate numbers of venting events were observed at Segments 3 and 4.



Deeper Water Segments - Pipeline Corridor Centerline (Mileposts 13 - 31)

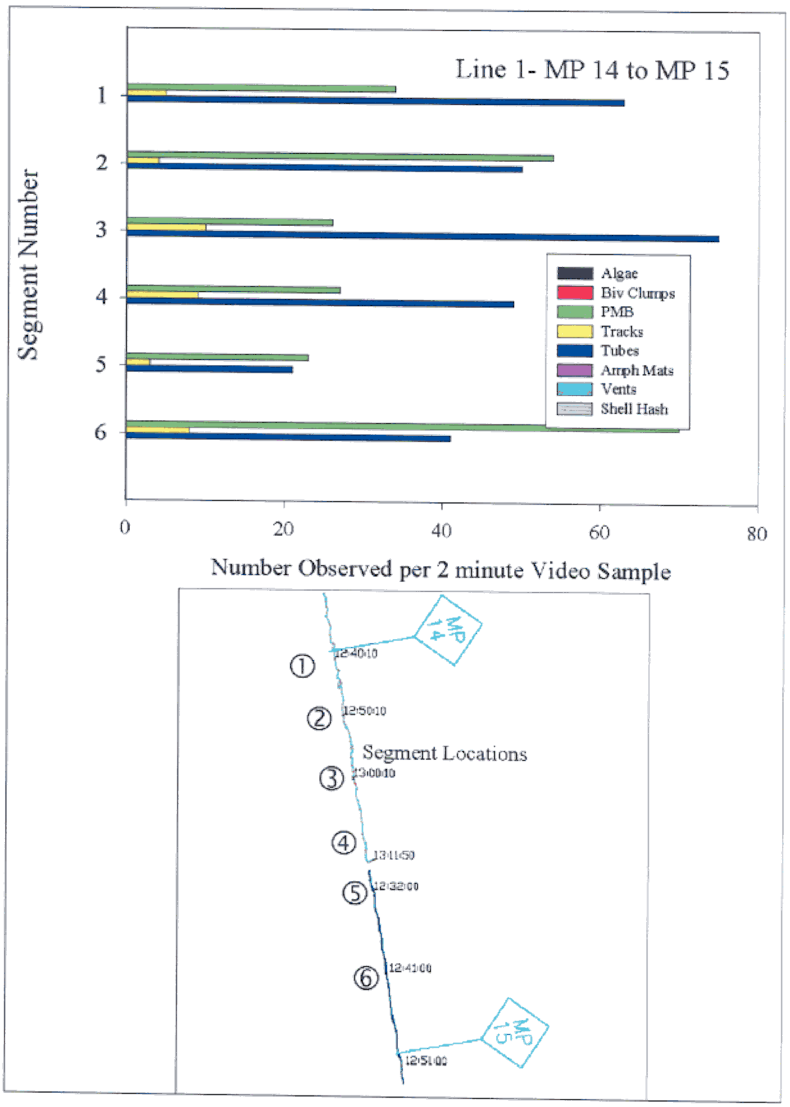
Line 1: Milepost 13 - 14

The sea floor between Mileposts 13 and 14 was comprised of bioturbated mud, as reflected in the high numbers of pits mounds and burrows that were found along the entire line. A few tracks, algae, shell hash and venting events were observed within various segments. The tubes were of mixed variety, but were mainly comprised (~ 60 %) of the hydroid *Corymorpha* and the burrowing anemone *Ceriantheopsis*. Large epifauna observed included sea robins and spider crabs (*Libinia emarginata*).



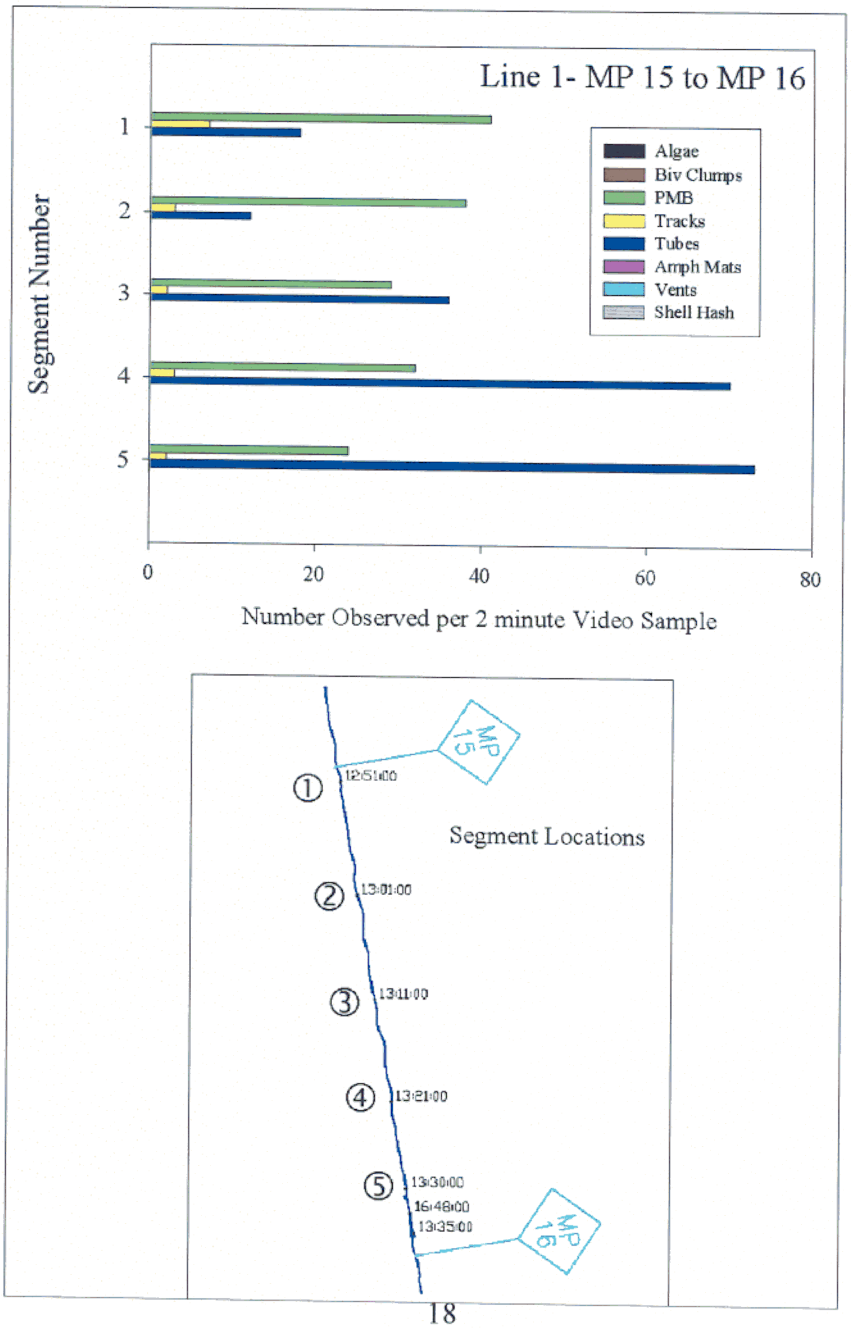
Line 1: Milepost 14 - 15

Continuing south past MP 14, the characteristics of the sea floor did not change to any great extent from the previous set of mileposts. The sediments appeared to be a bit sandier around Segment 3, with some small wave forms in spots. The number of dominant features increased relative to the previous section of Line 1 (MP 13-14), notably the number of tubes, along Segments 1 and 3 and the number pits, mounds and burrows along Segment 6. Tracks were the only other types of features observed along this section of the line. Epifauna observed along this portion of Line 1 included sea robins, skate and *Libinia* (spider crabs).



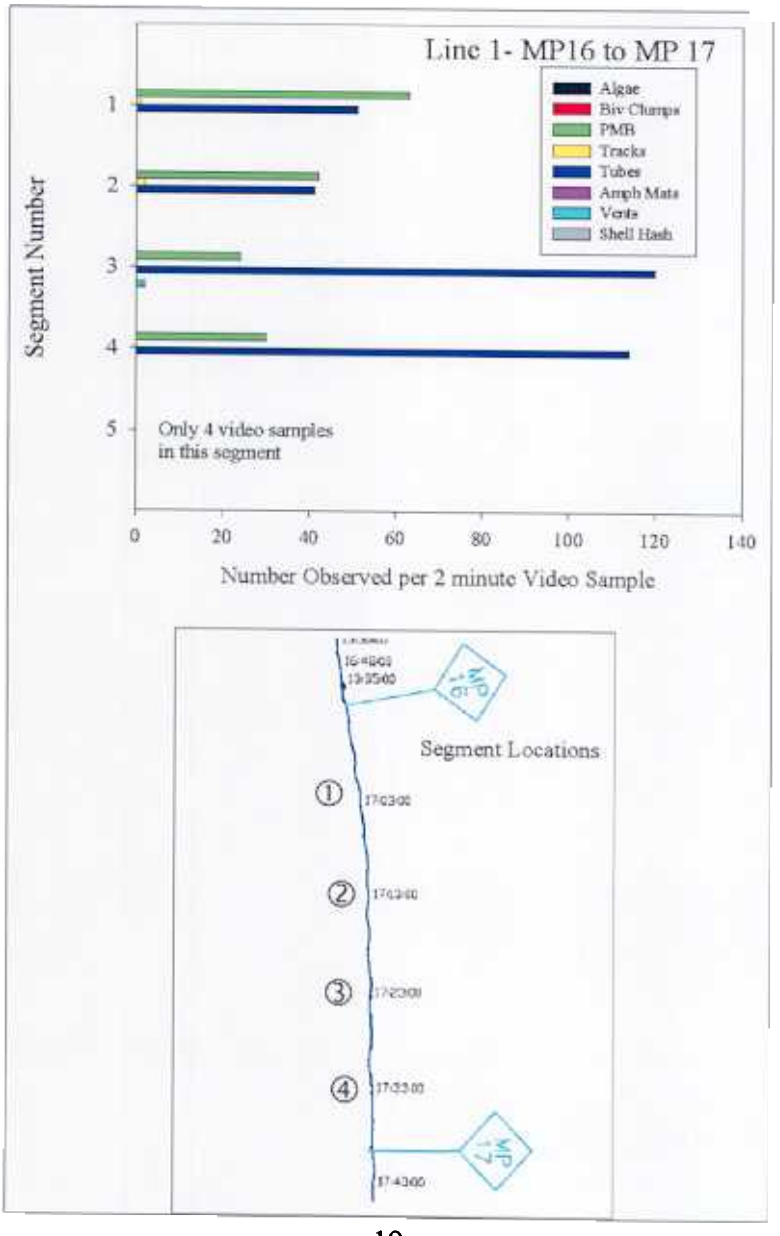
Line 1: Milepost 15 - 16

Tubes, tracks , and pits, mounds and burrows (PMB) continued to be the only surface features evident along this portion of Line 1. The number of PMB was fairly similar along each segment and there were few tracks. The number of tubes increased sharply between segments 3 and 4. The tubes appeared to be those of an unknown polychaete, although some *Corymorpha* were present. The only large epifauna observed included spider crabs along Segment 2.



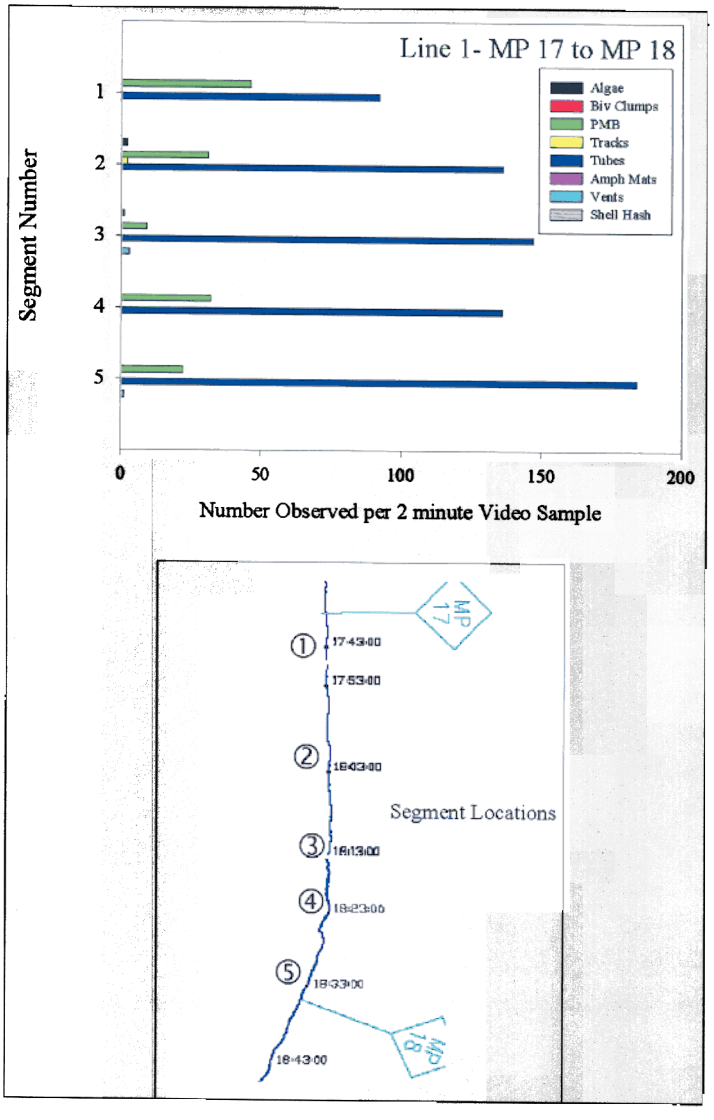
Line 1: Milepost 16 - 17

Moving past MP 16, the sea floor became more bioturbated with increased numbers of pits, mounds and burrows along Segments 1 and 2. The number of tubes increased over previous levels, particularly along Segment 3 and beyond. The high number of tubes generated a "tube field" appearance to the sea floor, with many patches of 2 or more tubes distributed across the entire field of view of the video records. The tubes appeared to made by polychaetes.



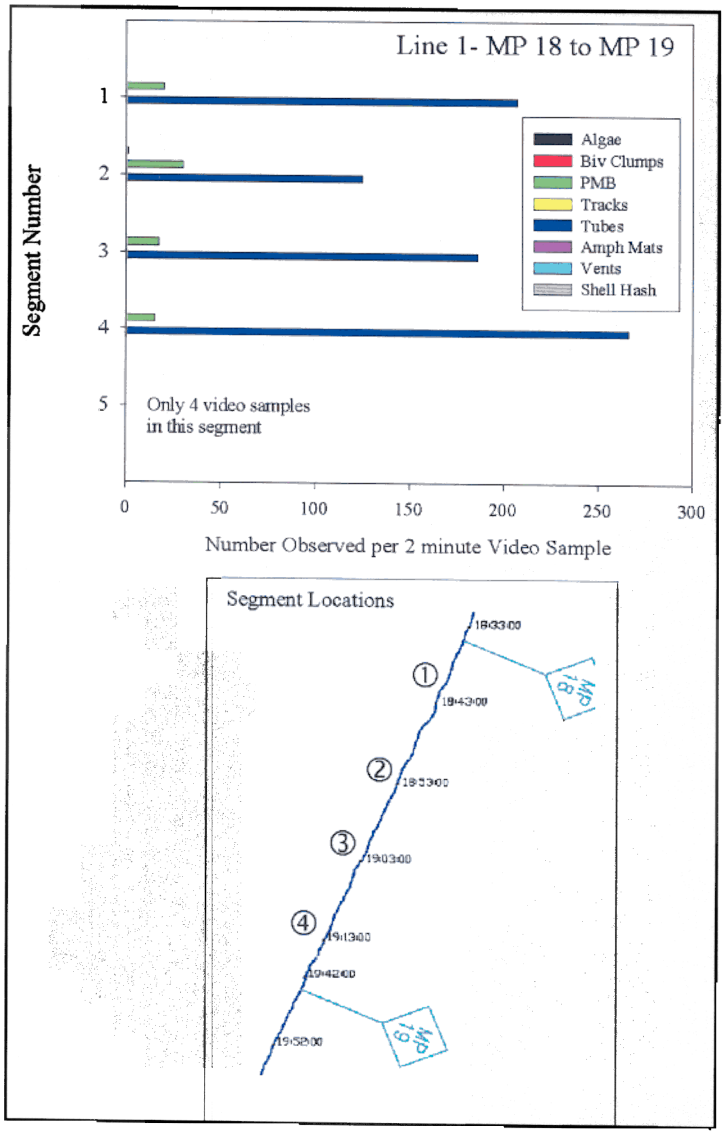
Line 1: Milepost 17 - 18

The features along this portion of Line 1 were very similar to that found between MP 16 and 17. The number of tubes increased between MP 17 and 18. These were mixed including polychaete tubes, *Corymorpha* and some *Ceriantheopsis*. Some of the tubes (~ 10 %) had beige to white colored sausage-shaped sacs protruding from their openings, one per tube. Although its is not known what these were, it is likely that they were some type of egg sac being made by the organisms living in the tube. Epifauna observed included spider crabs, flounder, and an unidentified fish in several of the burrows.



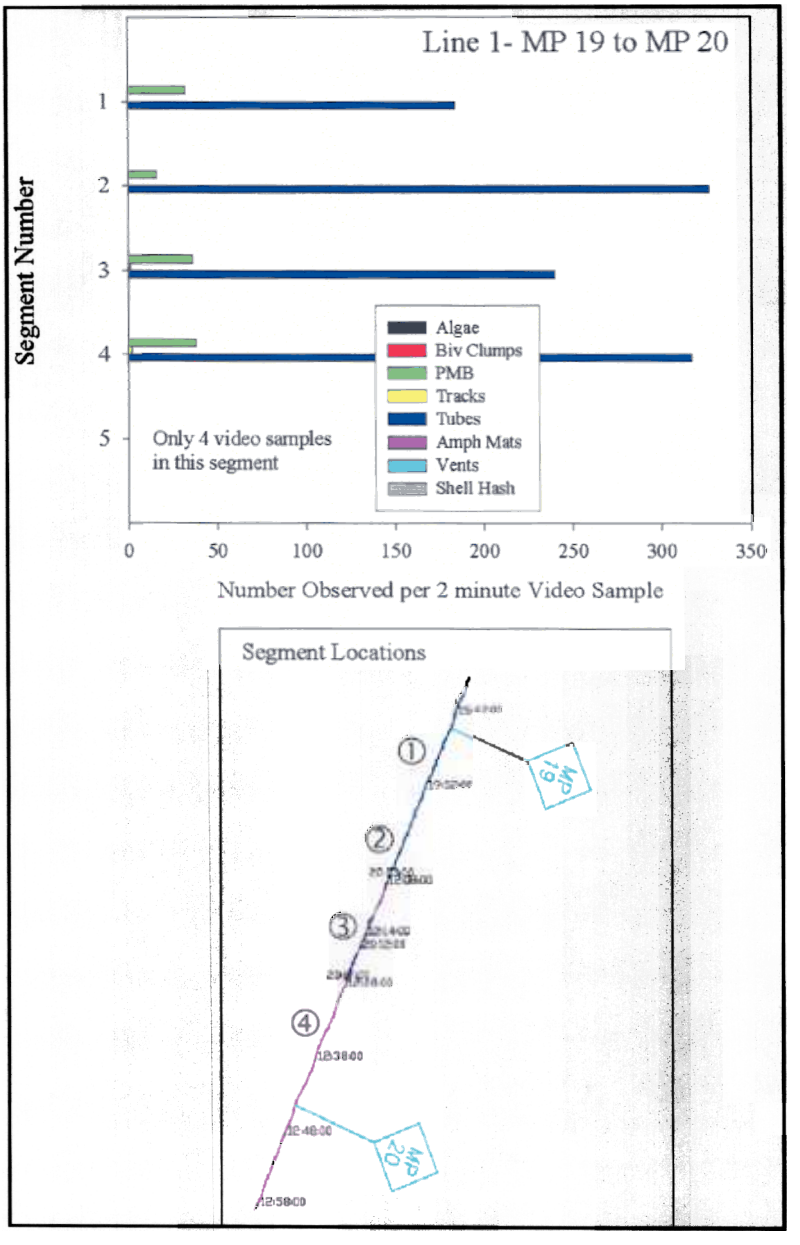
Line 1: Milepost 18 - 19

Tube fields were the dominant feature of this portion of Line 1, and increased in number somewhat relative to the previous section (MP 17-18). The tubes were of various types, some with the white sacs protruding from them. The sea floor was muddy and heavily bioturbated, with fairly constant numbers of pits, mounds and burrows along the line. One flounder was observed along this section of Line 1. Only four segments were sampled due to survey speed.



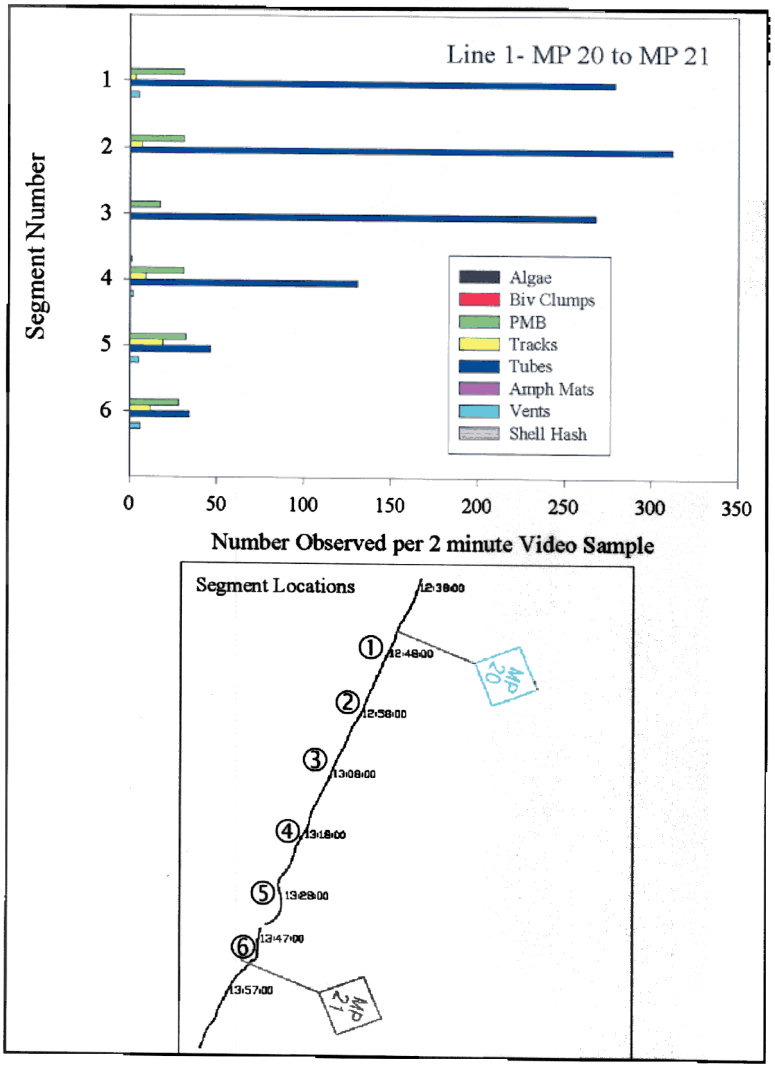
Line 1: Milepost 19 -20

The numbers of tubes on the sea floor continued to increase along this portion of Line 1. They were of a mixed variety. The number of pits, mounds and burrows remained similar, ranging from 16 to 40 per 2 minute video transect. Epifauna observed included several lobsters (3) in burrows, and squid. Only four segments were sampled due to survey speed.



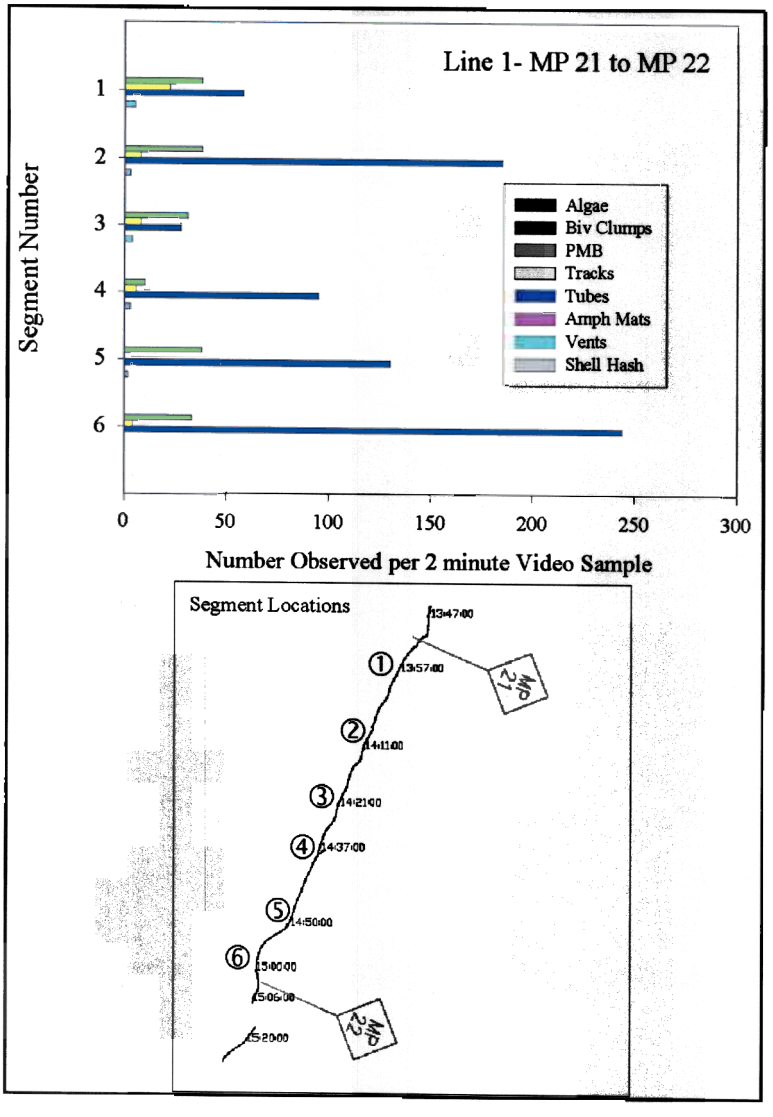
Line 1: Milepost 20 - 21

Large numbers of tubes continued to be found between Segments 1 and 3 between MP 20 and 21, but the numbers dropped sharply along segments 4 and 5. The number of pits , mounds and burrows remained similar, however the number of tracks on the sediment increased, particularly along Segments 5 and 6. The tracks found along Segments 5 and 6 included those created by epifauna such as snails and crabs, but most were fairly large and appeared to be formed by human activities such as trawling or anchor dragging. The sizes of the burrows appeared to increase along this portion of Line 1 and one lobster was observed in a burrow.



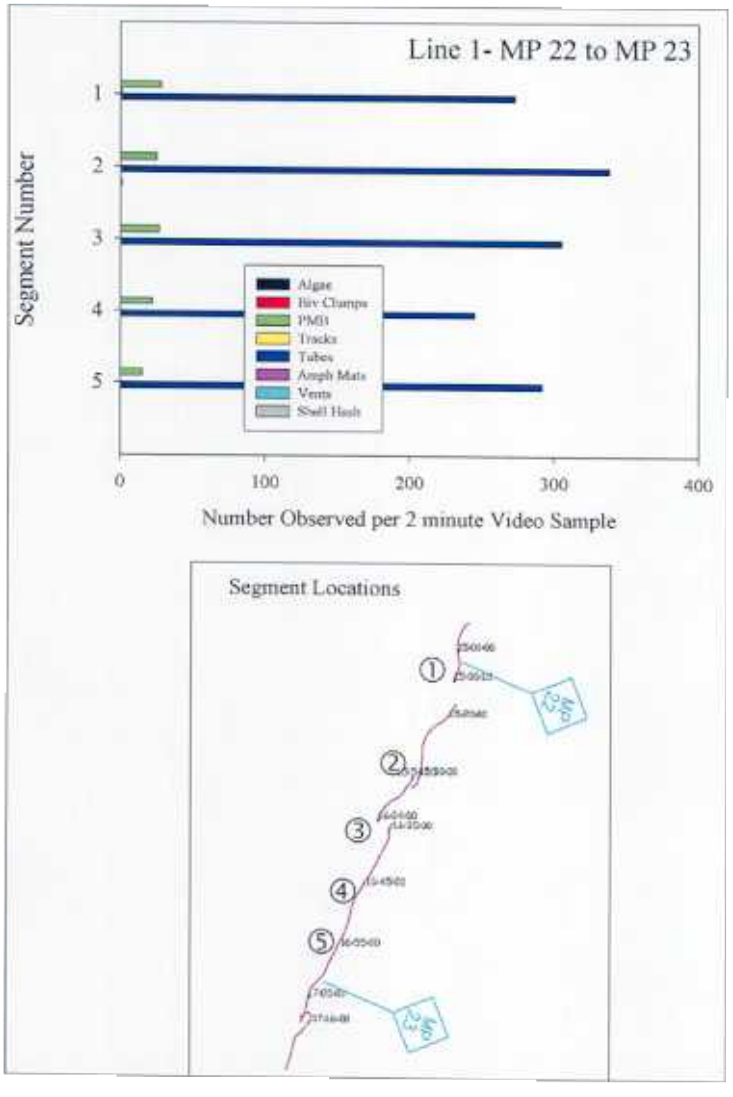
Line 1: Milepost 21 - 22

MP 21 is found near the Connecticut - New York border in Long Island Sound. The sea floor continued to be muddy, and bioturbated. There was a high number of large tracks along Segment 1 and 2, indicating a large area that was disturbed in some fashion stretching from Segments 4 and 5 in the previous section to this area. The tracks also had chunks of overturned sediment associated with them and ripple marks. These observations suggests that this area has been trawled. The number of tubes was variable between MP 21 and 22, with a high number along Segment 2, low numbers along Segment 3, and then increasing numbers from Segments 4 through 6. The number of pits, mounds and burrows was fairly similar among segments. The epifauna observed included skate, lobster and large aggregations of spider crabs (~ 20 - 30 crabs) between Segments 1 and 2. These aggregations may occur as part of their reproductive behavior.



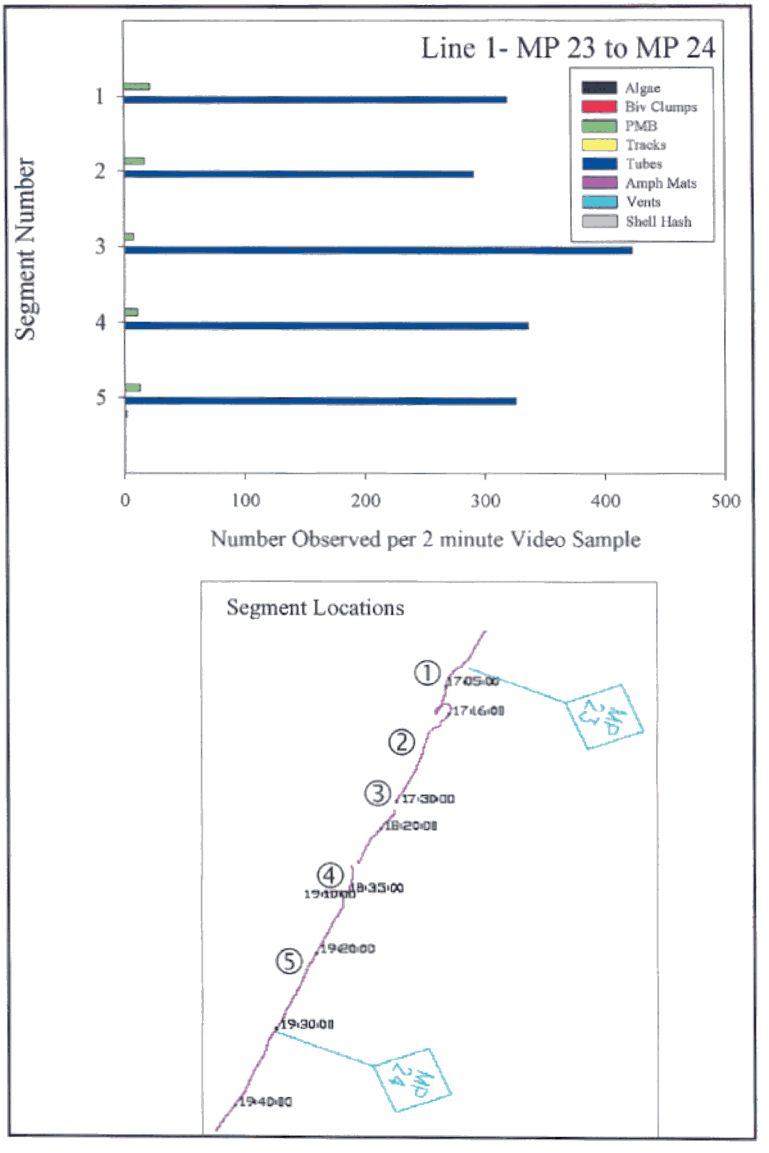
Line 1: Milepost 22 -23

This and the following sections of the pipeline corridor fall entirely within the New York portion of Long Island Sound. The sea floor continued to be muddy, and bioturbated. The large tracks seen in the previous section were not found, but the number of pits and burrows decreased and the number of tubes increased. The numbers of each of these features was similar along each video segment analyzed. No epifauna were observed.



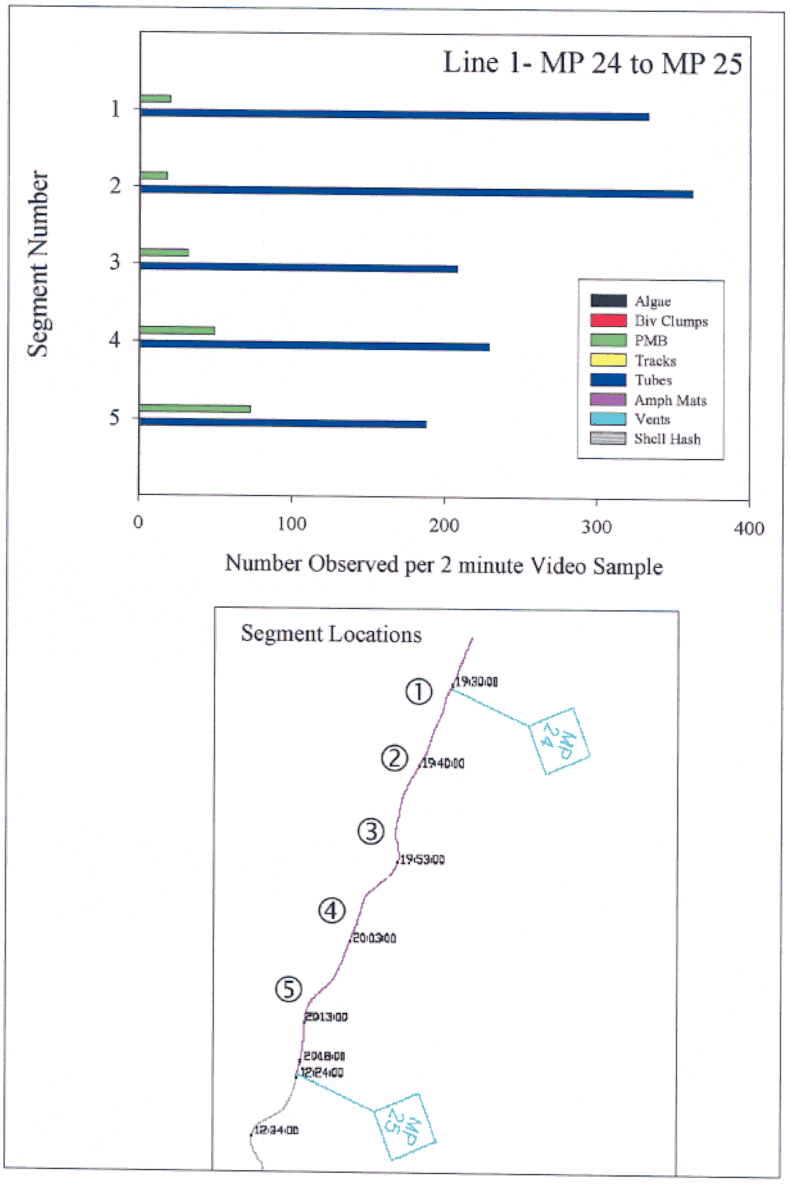
Line 1: Milepost 23 -24

The sea floor continued to be muddy, and the dominant features were tubes. The number of tubes increased relative to the previous two sections, and the number of burrows was slightly lower. The tubes were distributed as a fairly continuous bed across the sea floor, with small patches of higher aggregations. It is likely that the tubes are created by polychaetes and /or amphipods. No epifauna were observed.



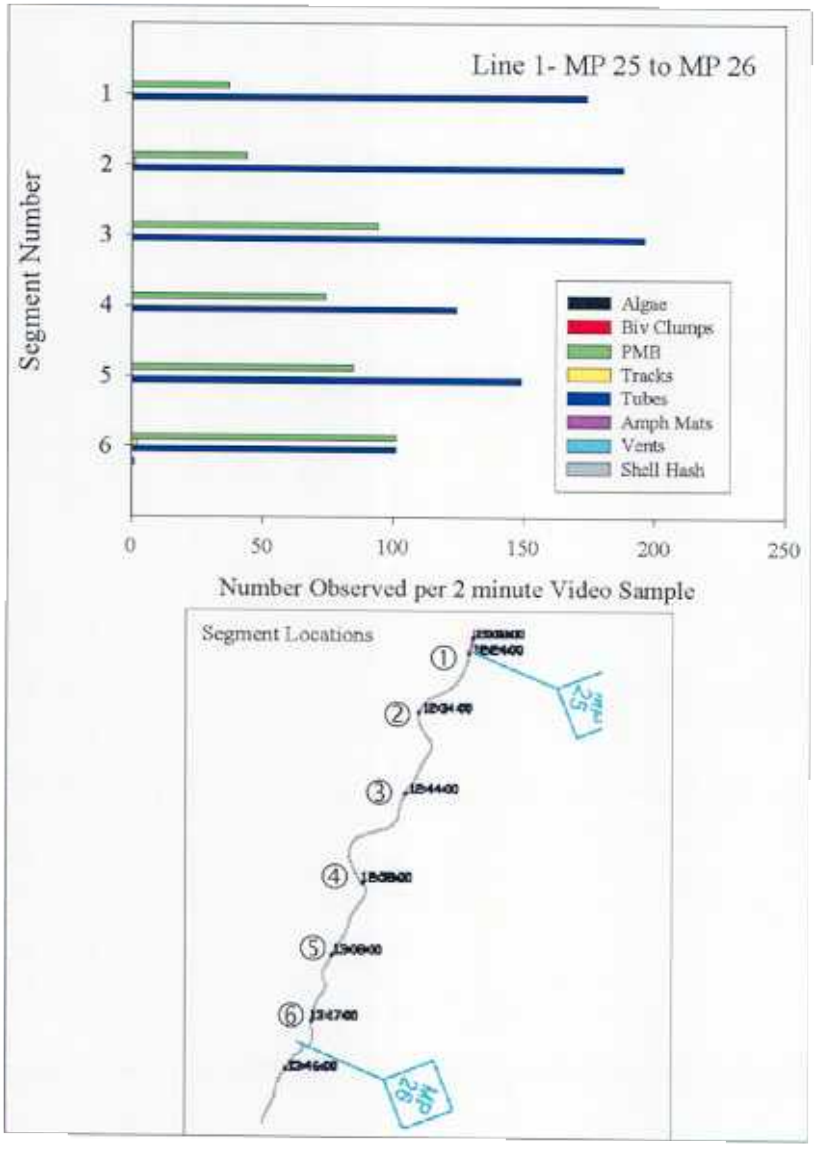
Line 1: Milepost 24 -25

This section of the pipeline corridor was very much like the previous section. The sea floor continued to be muddy, although in the area of segment 3 there was more shell on the surface, and the sediments appeared somewhat sandier. The dominant feature was the extensive tube bed. The number of pits, mounds and burrows was relatively low at the northern part of the section but increased to the south.



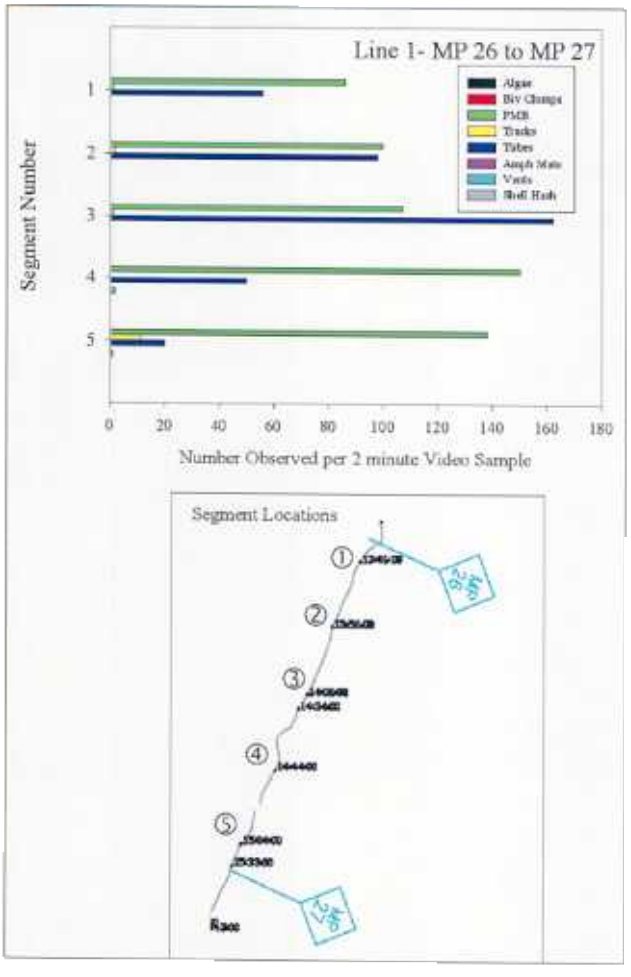
Line 1: Milepost 25 -26

This section of the pipeline corridor was comprised of muddy sediments. The number of tubes decreased relative to the previous sections of the corridor just to the north. The number of pits, mounds and burrows was relatively low along the first two segments, but increased significantly from Segment 3 to Segment 6. There were no other readily evident features on the sea floor along this section. One venting event was observed along Segment 6.



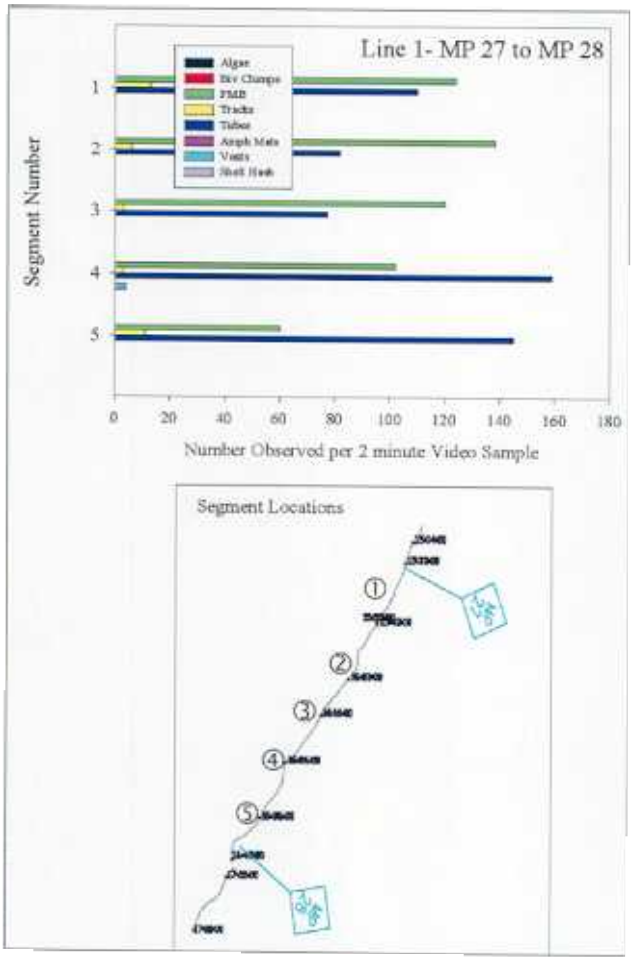
Line 1: Milepost 26 - 27

This section of the sea floor was more bioturbated than the previous sections just to the north, as was reflected by the increasing numbers of pits, mounds and burrows along each of the segments that were analyzed. However, the numbers of tubes was still high along segments 1, 2 and 3. Several of the features identified as tubes may be stalked hydrozoan colonies. Several venting events were observed along Segments 4 and 5. There was a relatively large number of tracks observed along Segment 5.



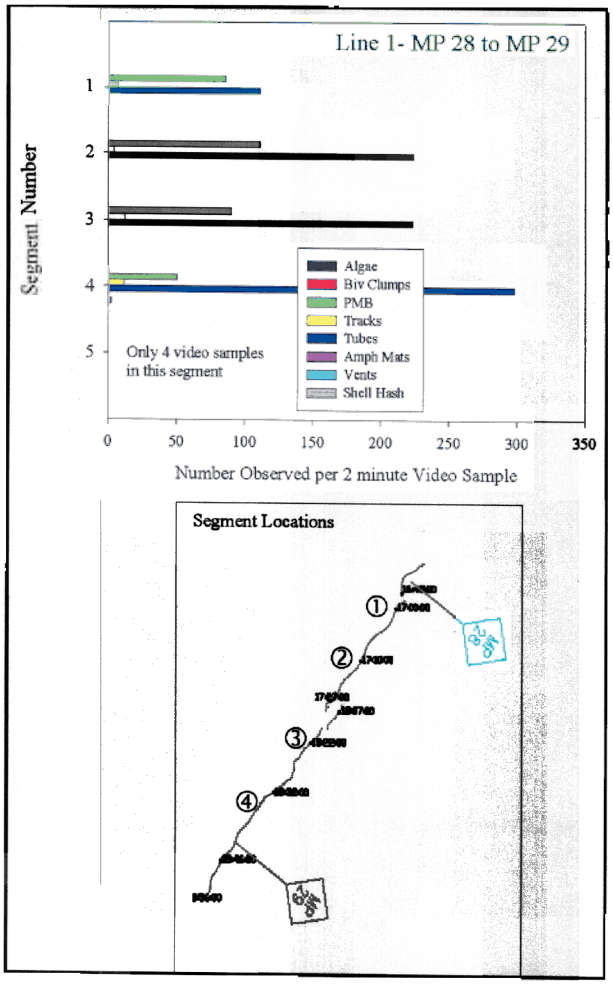
Line : Milepost 27 - 28

Tracks were observed along each segment analyzed from this section of the pipeline corridor. These appeared to be trawl marks, although only a few were found along Segments 2, 3 and 4. There were relatively high numbers of pits, mounds and burrows along the entire segment, as well as fairly high numbers of tubes. The PMB were of varied sizes. This suggests that this area may have been trawled sometime in the past and some degree of recovery has occurred. The sediments along Segments 3 and 4 were highly bioturbated with large burrows in which lobster were visible. Just before segment 2 the ROV came upon a lobster trap with several lobsters around it and in the trap. Several *Cancer* crabs were observed. The sediments appeared to be a bit sandier along the southern portion of the section.



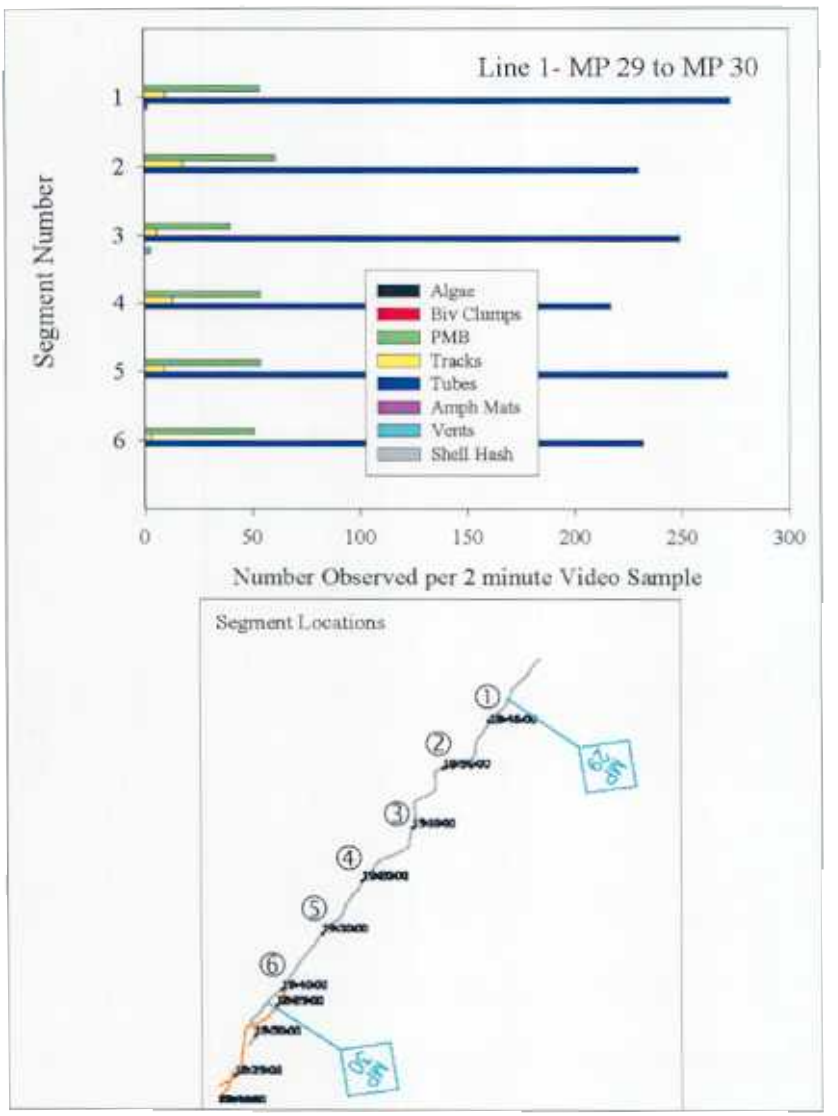
Line 1: Milepost 28 -29

The number of tubes increased dramatically from Segment 1 to Segment 4 along this portion of the pipeline corridor. The number of pits, mounds and burrows was relatively high. Tracks were evident particularly along Segments 3 and 4. Epifauna observed included eels and spider crabs.



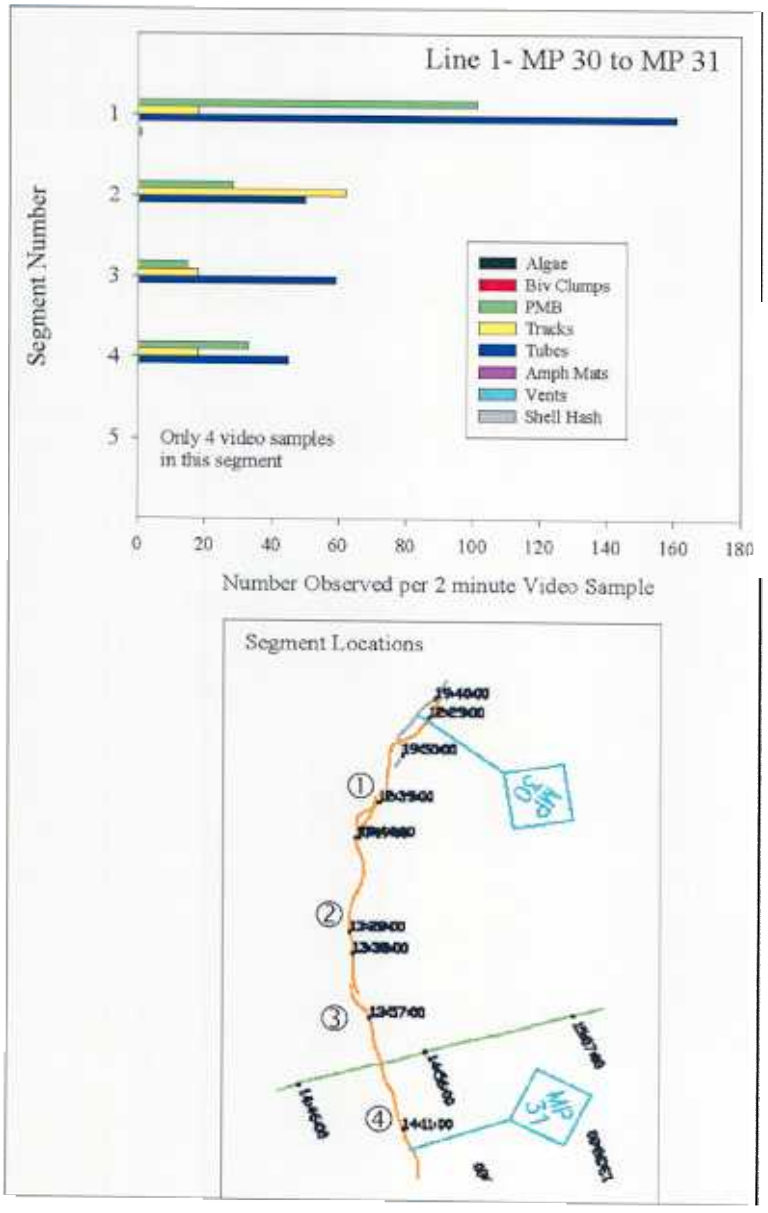
Line 1: Milepost 29 - 30

The sea floor in this section appeared to be muddy sand, and high numbers of tubes continued to be the dominant features on the sea floor. The number of tubes was high relative to previous corridor sections, and the number of burrows was slightly lower. The tubes were distributed as a fairly continuous bed across he sea floor, with small patches of higher aggregations. The tubes were of diverse sizes. The burrowing anemone *Ceriantheopsis* and the stalked hydrozoan *Corymorpha* appeared make up a small portion of the tube category. It is likely that most of the tubes, however, were created by polychaetes and /or amphipods. Tracks were evident along each segment. Epifauna observed included flatfish, lobsters and spider crabs.



Line 1: Milepost 30 -31

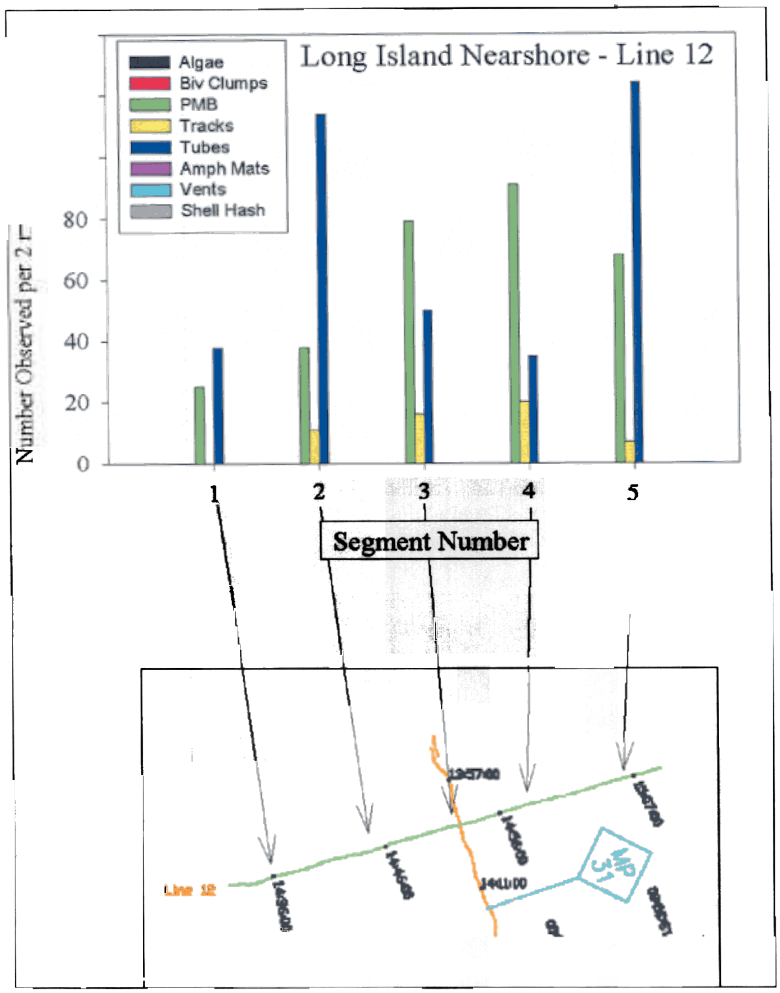
This section of the sea floor is where the pipeline corridor turns to the south east as it approaches the north shore of Long Island. There were very high numbers of tracks on the sea floor, and these appeared to mostly produced by human activities (e.g. trawling, anchor drags). There were relatively low numbers of tubes and pits mounds and burrows along this sections of the corridor, likely due to the disturbances related to the tracks. The PMB also had a low relief, and not as pronounced as in more northerly sections of the corridor. The level of suspended sediment in water column was high. A large (~ 30 - 40 individuals) aggregation of spider crabs was observed just past Segment 2. Epifauna observed included spider crabs, several lobsters and a flatfish.



Long Island Shore Lateral Survey Lines

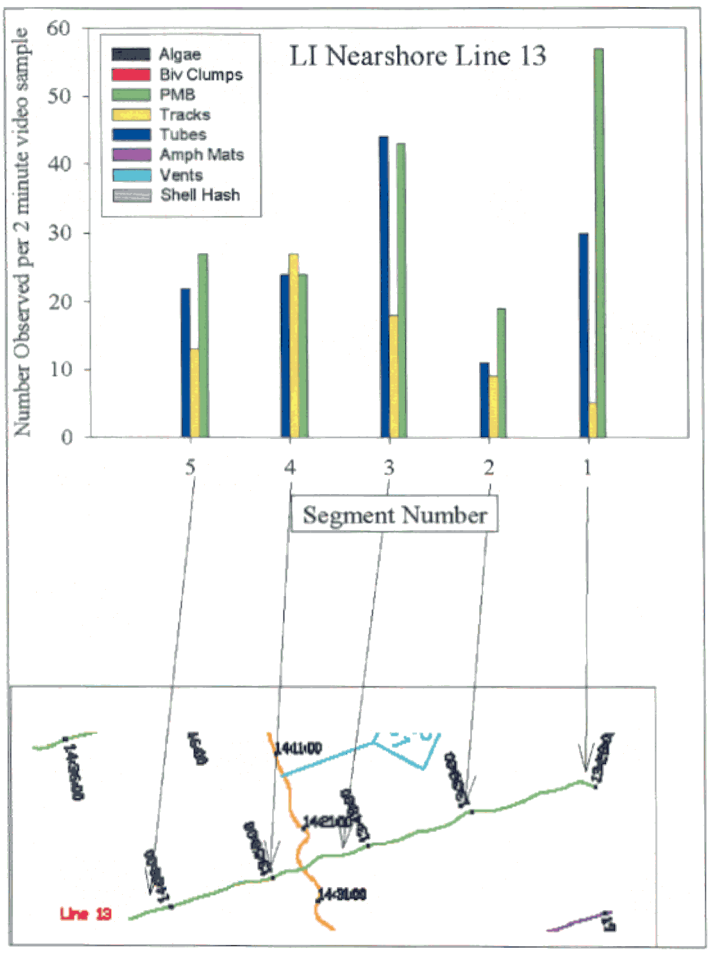
Long Island Line 12

The western portion of this line was comprised of muddy sediments, with relatively few tubes and pits, mounds and burrows. Most of the PMB had a low relief. A moderate number of tracks were found along segments 2, 3and 4. The tracks were likely due to trawling or other human activities. Fewer tracks were found toward the eastern end of the line, and more tubes were found in this area. many of the burrows were also small, although some larger burrows were found along Segment 3.



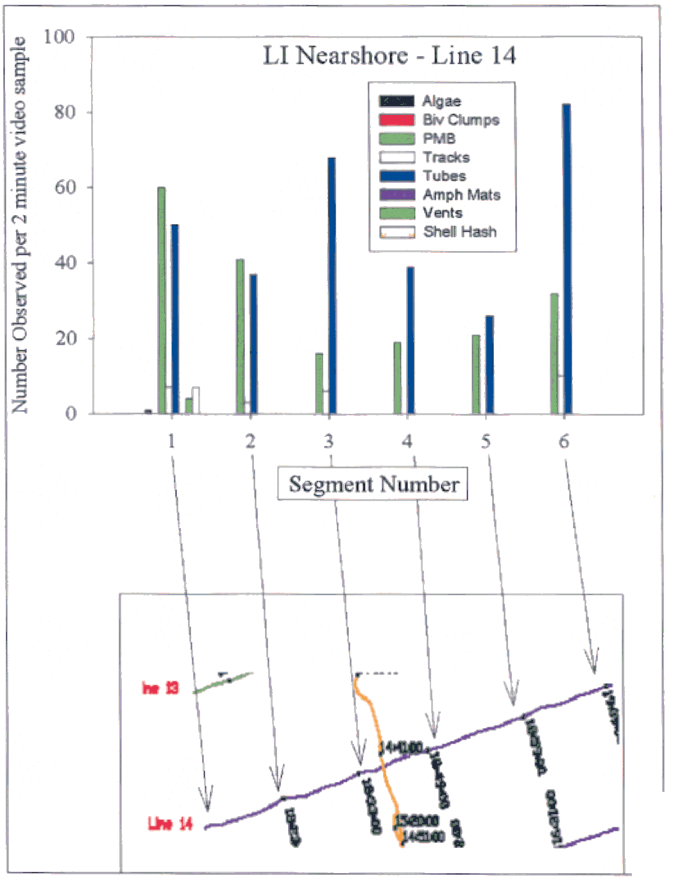
Long Island Line 13

Line 13 also had moderate numbers of tubes and pits, mounds and burrows at its eastern and lower numbers were found along segment 2, and then moderate numbers again along the rest of the line to the west. Moderate numbers of tracks were found along Segments 1and 2 and then increased along Segments 3and 4. The sediments were muddy and the features were low relief. There were patches of bottom where no features were seen. Observed epifauna included spider crabs and flatfish.



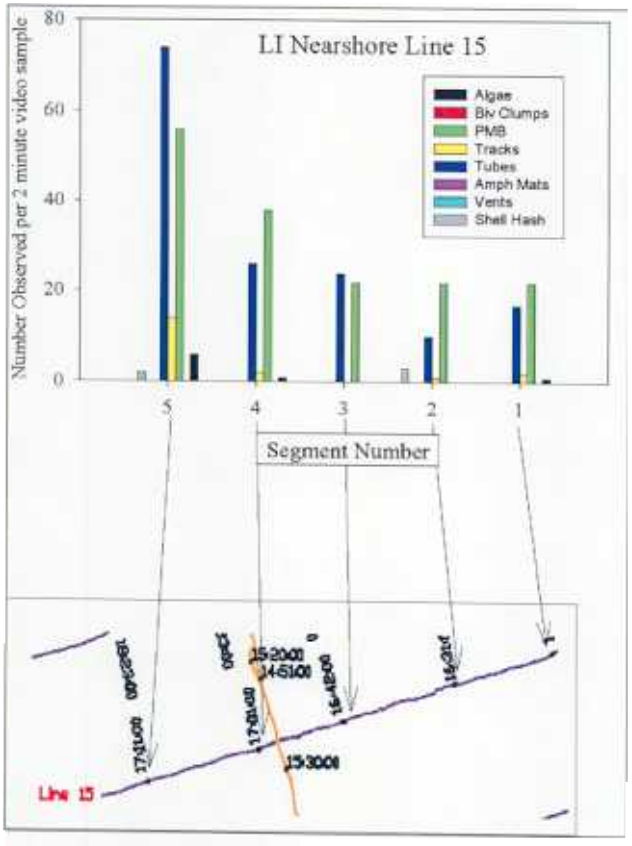
Long Island Line 14

Long Island lateral Line 14 was characterized by a sandy mud bottom with scattered shells. There were variable numbers of pits, mounds and burrows. The number of tubes along each segment was also variable, but these tended to be higher in number. Some tracks were seen along Segments 1, 2 and 3. Tracks were also observed along Segment 6. Between segments 2 and 3 a large aggregation of starfish was observed, likely feeding on carrion.



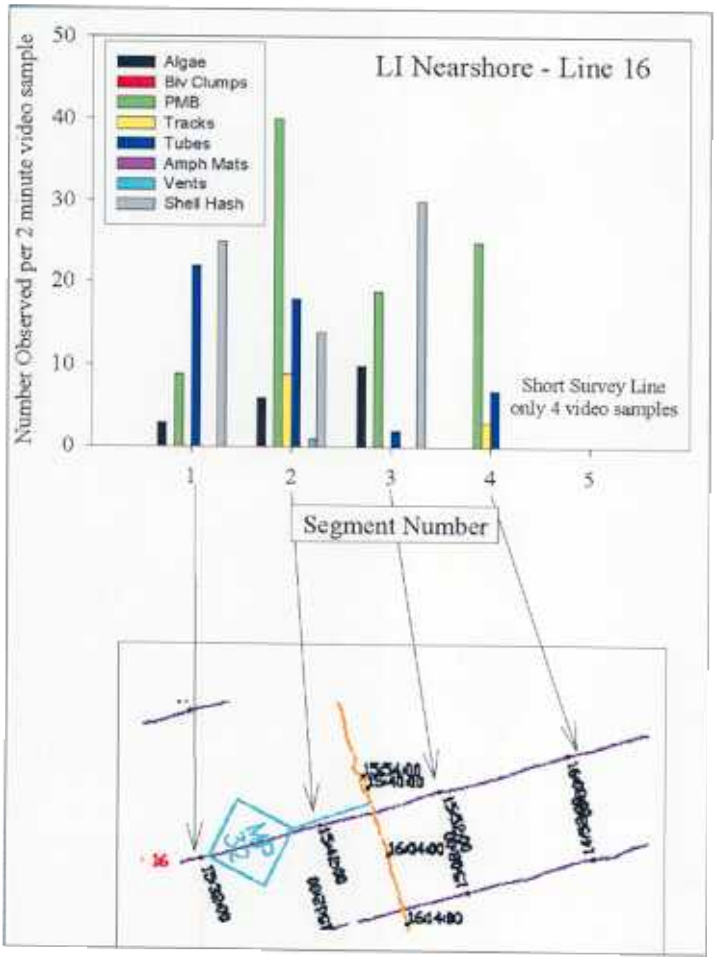
Long Island Line 15

This lateral line was comprised of a fairly flat, featureless muddy-sand bottom. Relatively few surface features were found between Segments 1and 4. Along Segment 5 more features were found, including some algae, a moderate number of tracks, and higher numbers of tubes and pits, mounds and burrows. Many spider crabs were observed along the entire length of this line. There was a lot of suspended material in the water column. Between Segment 2 and 3 there was a rock with a fouling community.



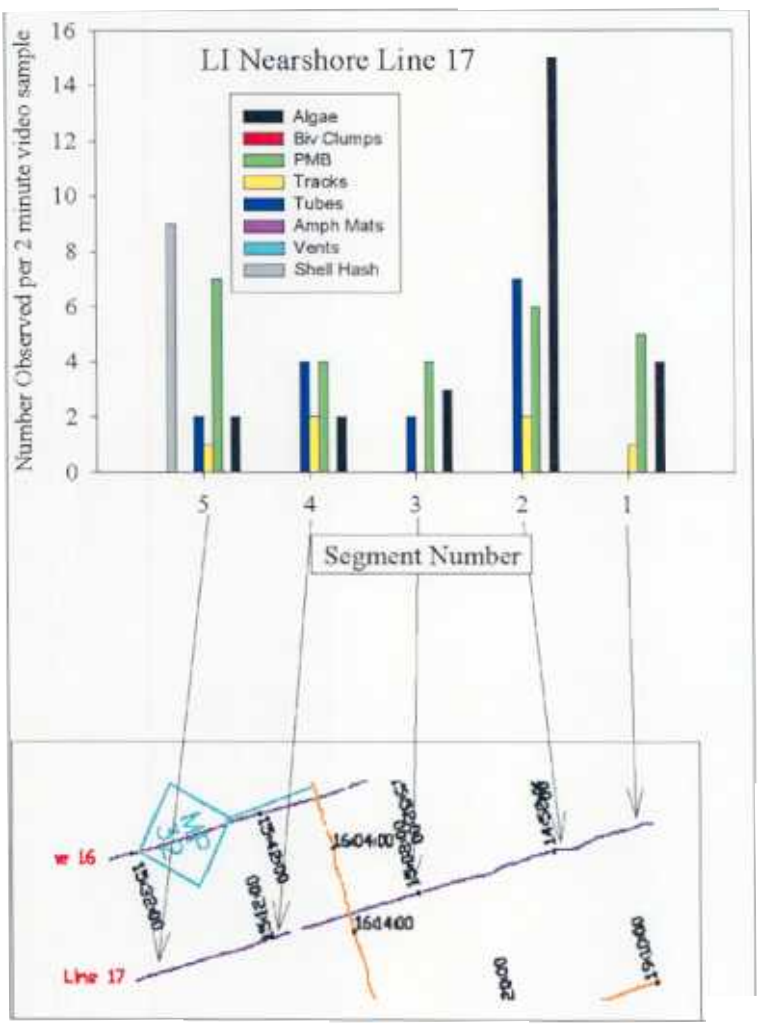
Long Island Line 16

Visibility conditions along this line continued to be poor, with high amounts of suspended materials in the water column. The bottom is fairly flat and appeared to be comprised of muddy sand. There was also a pronounced increase in the amount of shell hash on the sediments. The shell hash was comprised of razor clams, hard clams, and several other unidentified species. Algae were found along Segments 1, 2 and 3. There were relatively low numbers of tubes, and pits mounds and burrows along Segments 1 and 3.



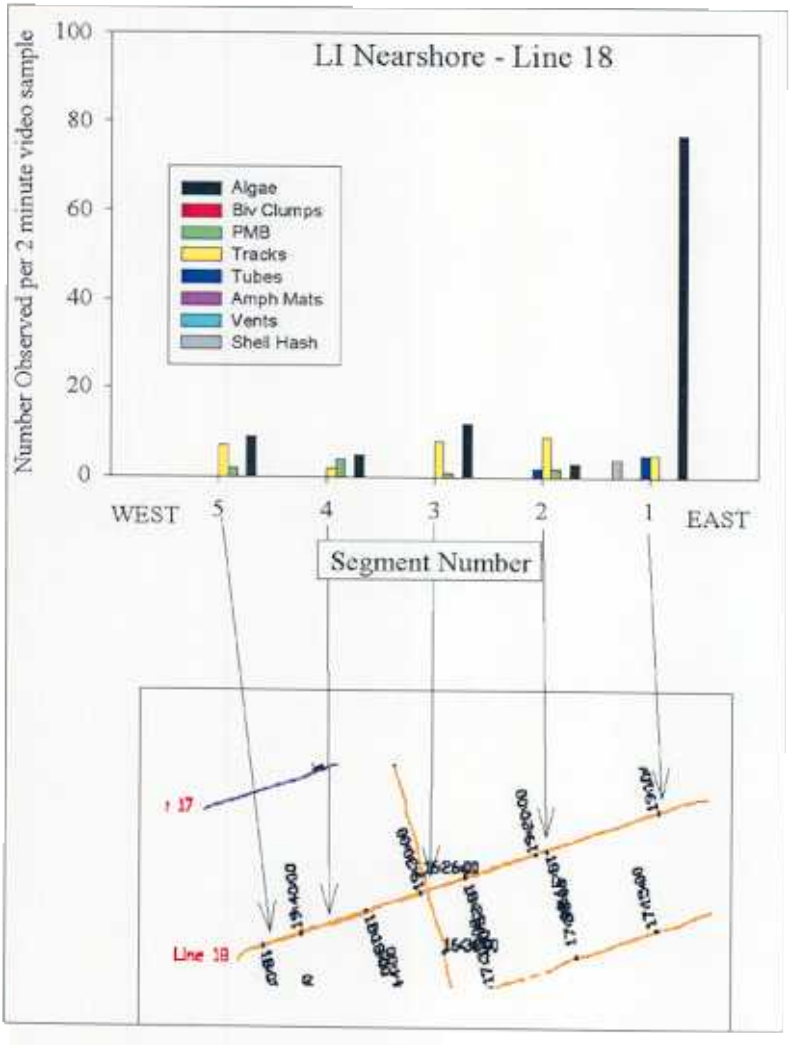
Long Island Line 17

The general nature of the sediments changed between Lines 16 and 17. The sediments along Line 17 were primarily sands with some mud. The sea floor also had distinct bed forms, consisting of small sand waves. Small rocks were sparsely distributed along the sea floor. There appeared to be algae, or perhaps small hydroids, along the ridges of these small sand waves. Very few surficial features were observed along most of the segments. The epifauna was solely comprised of starfish.



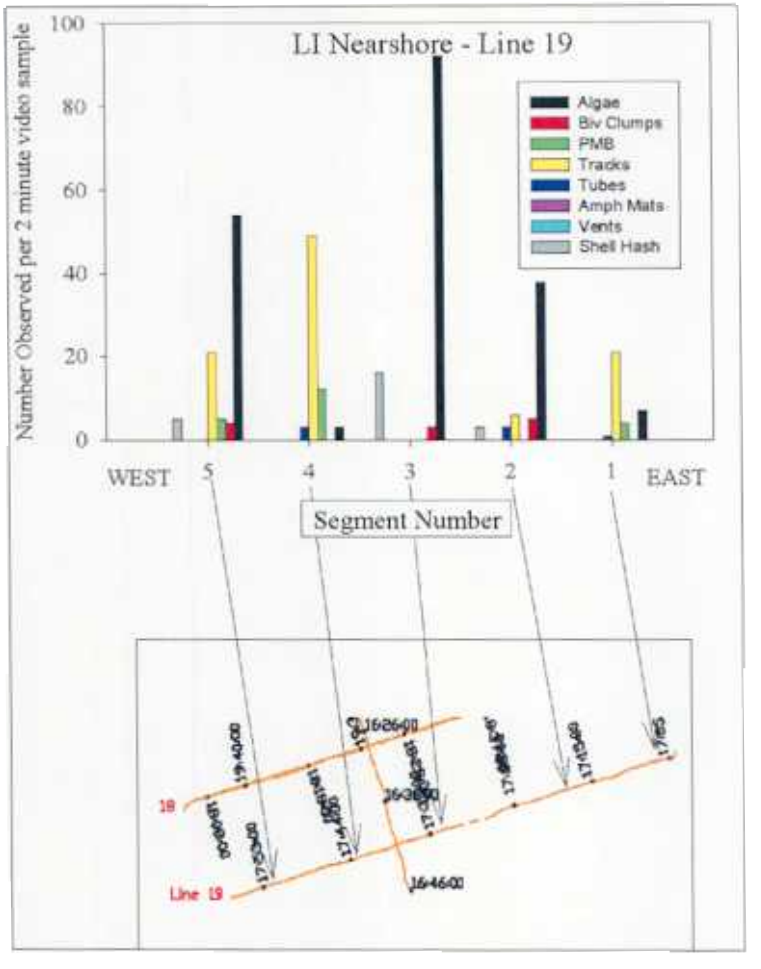
Long Island Line 18

Sediments along Line 18 were sands and the bottom topography was primarily comprised of small sand waves. Cobbles and shells were distributed among the sand waves, but there were no distinct patches of shell hash except along Segment 1. There was also a large amount of algae attached to the cobbles and shells along Segment 1. There were very few other surface features observed along this line. The epifauna included primarily spider crabs and there were also a number of egg cases of moon snails.



Long Island Line 19

Sediments along the Line 19 were sands with a sand wave topography. In some areas kelp and other algae were seen in the troughs of the sand waves. There also appeared to be a fine blanket of benthic microalgae distributed across the sediments. There were also rocks and bivalve clumps in some areas. The bivalves appeared to be primarily mussels, but these were difficult to determine specifically in some cases because of the algal covering. There were extensive patches of shell hash along segments 2 and 3. The most abundant feature was the attached algae which was found in particularly dense patches along segments 3 and 5.



Summary:

Connecticut Nearshore:

The Connecticut nearshore is comprised of a heterogenous, but primarily mud bottom. There were several areas, primarily at the ends of Lines 4, 5 and 7 where coarser sediments were observed, associated with what appeared to be boulders or rocky outcrops. These were primarily found along the eastern end of the lateral lines which were near the Thimble Islands (Fig. 1).

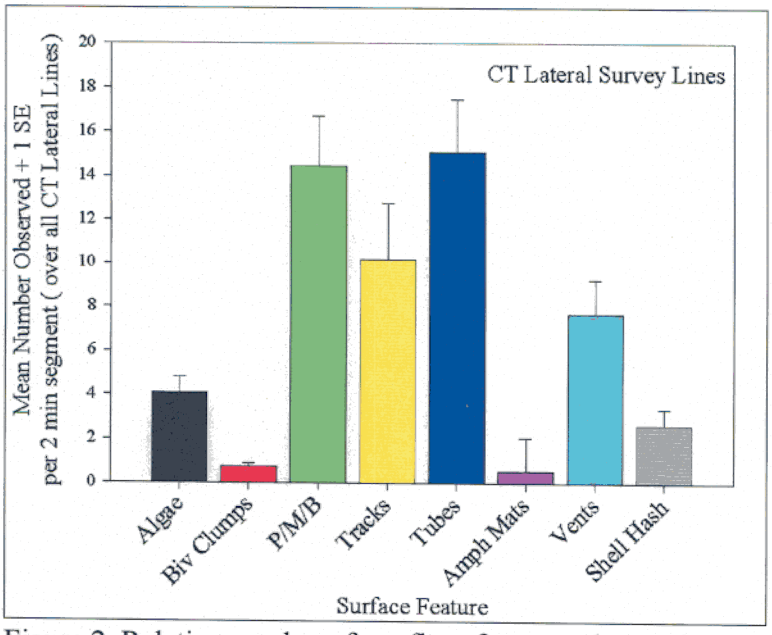


Figure 2. Relative number of sea floor features observed over all CT lateral survey lines.

Overall, the most numerous features found along the CT lateral survey lines were pits, mounds and burrows (P/M/B), tracks and tubes (Fig. 2). Relatively high numbers of venting events were also observed, indicating that a fair number of infaunal bivalves and/or burrowing crustaceans are found in this area. Not many clumps of epifaunal bivalves (i.e. oysters and mussels) were observed, although some larger mussels beds were found along the eastern end of the lateral lines (e.g. Line 9). Algae were also found mostly along the eastern ends of the survey lines, associated with the scattered rocky outcrops and boulders that occur along this side of the pipeline corridor. Amphipod tub mats were found in several locations. Although the mean number per segment is low, some of these (e.g. along Lines 6 and 8) were fairly extensive in area, ~ several m^2. In a previous side scan survey of the pipeline corridor several features between the HDD and MP 13 were identified as submerged aquatic vegetation (SAV) along the western side of the corridor. These areas coincide with where amphipod mats were found, but little algae, suggesting that these are not SAV beds but habitats with elevated numbers of amphipod mats. Most of the tracks in the Connecticut nearshore were small, made by snails and/or crabs. However, along Lines 9 - 11 some of the tracks were large and appeared man-

made, coinciding with trawl marks that were found in the previously conducted side scan sonar.

Many of the sea floor features quantified were found along each of the CT lateral lines, but there was a decrease in the variety of features in the pipeline corridor moving south from Line 2 to Line 11. There were also sharp changes in line features from one line to the next in some areas. For example, Line 5 was characterized by few features, but Line 4 to the north and Line 6 to the south were comprised of a greater variety and number of features. Observed epifauna megafauna included primarily the spider crab *Libinia*, and a few flounder.

Pipeline Corridor Centerline Survey

Moving into deeper waters, the sea floor landscape is a bioturbated mud bottom. Silty muds were prevalent along most of the 18 milepost (MP) sections examined (MP 13 - 31), but sandier sediments were found along the last few centerline segments prior to the NY lateral lines (MP 29 - 31). Tubes and pits, mounds and burrows were almost exclusively the only features which comprised sea floor habitat features in these deep water sections of the pipeline corridor (Figure

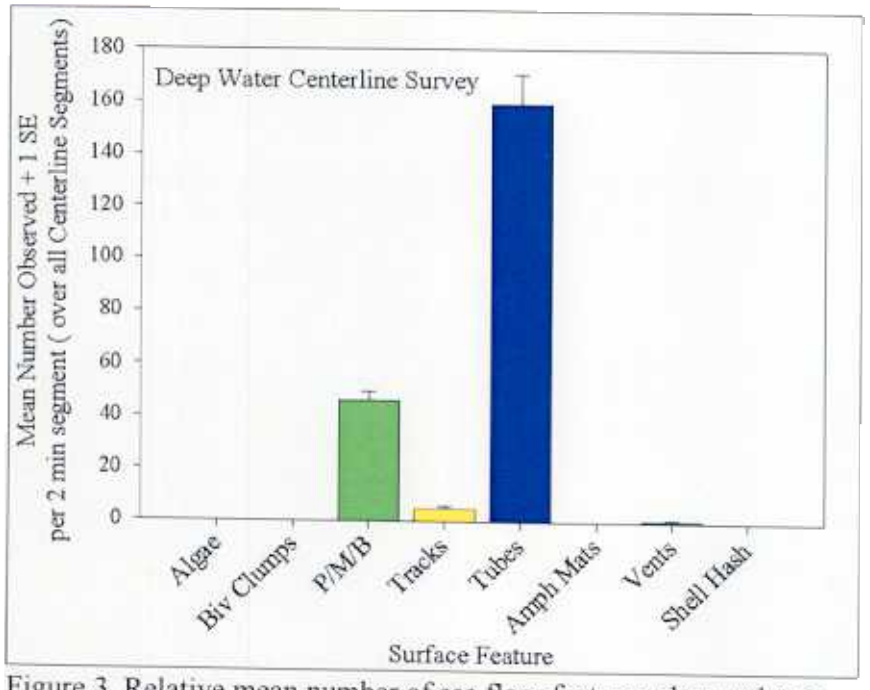


Figure 3. Relative mean number of sea floor features observed over all deep water centerline segments between MP 13 and MP 31.

3). The pits mounds and burrows gave the sea floor its highly bioturbated character. The tubes were comprised by a combination of polychaete, and some amphipod, tubes, the erect hydroid *Corymorpha pendula* and the burrowing anemone *Ceriantheopsis americana*. An unidentified erect colonial hydrozoan comprised some of the tube category at the southern end of the

centerline survey (MP 29- 31). The tubes were distributed in clumps and individually, and in some areas created what could be described as tube fields, i.e. spatially extensive sets of tube clumps of varying sizes and tube densities. However, these were not similar to the distinct mats formed by amphipods. The pits, mounds and burrows were of mixed sizes, and distributed in a fairly uniform fashion where they were found in high numbers. In a few areas they appeared more clumped, creating extensive galleries of pits and burrows. Although Tubes and P/M/B comprised almost all of the sea floor habitat features in this portion of the survey, there were large-scale spatial differences in their relative abundance. Tubes were the predominant feature between MP 13 and 24. Between MP 24 and MP 28 there was an increase in the relative numbers of pits, mounds and burrows. Between MP 28 and MP 29 there was a transition from more P/M/B to greater numbers of tubes. Between MP 29 and MP 30, high numbers of tubes were found, but these decreased in number, as well as P/M/B numbers between MP 30 and MP 31. This decrease coincided with the presence of large tracks on the sea floor which were likely created by trawling or some other human activity. The topographic relief of the P/M/B was also lower in this trawled area than that observed along other milepost segments. Trawl tracks were also observed between MP 20 and MP 22, and between MP 27 and MP 28.

Epibenthic megafauna appeared to be more numerous in this portion of the survey. Spider crabs, *Libinia emarginanta,* were the most frequently (42% of the MP segments) observed epifauna, followed by lobsters, Homarus americanus (39% of the MP segments), and flatfish (22% of the MP segments). Some of the lobsters were observed in pits and burrows. Other epifauna observed included skates, sea robins, eels and *Cancer* crabs.

Long Island Nearshore

Sea floor habitats along the NY lateral survey lines were characterized by sharp gradients in bottom sediment type and associated features. Lines 12 and 13 were similar to the southernmost segments of the centerline survey, with a mud bottom and tubes, PMB and tracks comprising the primary sea floor features. At Line 14 the sediments became more sandy. Muddy sands were found along Lines 15 and 16, and by Line 17 bottom sediments had changed to sands with small sand waves in most areas. Sands and sand waves were found along Lines 18 and 19, where small cobbles and rocks were also observed.

The most numerous sea floor features continued to be tubes, and pits mounds and burrows along the NY lateral survey lines (Figure 4). Most of these were found along the northernmost lines (Lines 12 - 16). Tracks were found in high numbers along almost all of the NY lateral lines. Along Lines 12 and 13, and to a lesser extent along Lines 14 and 15, the tracks were man made likely form trawling activities. Along Lines 15 - 18 the tracks were primarily create by epifauna. Algae was another significant sea floor feature, particularly along the lateral lines closest to shore. Algae were first observed along Line 15 and became more abundant shoreward. Along Lines 15 - 17 the algae were primarily filamentous forms growing on the sand wave ridges and troughs. Along Lines 18 and 19, algae were the most conspicuous sea floor features. The diversity of the algae increased, and was comprised of filamentous forms as well as green and brown algae of several types. These were attached to rock, cobbles and shell hash.

Some bivalve clumps were observed along Line 19, and these were all mussels. Large epifauna observed included spider crabs (along all of these lateral lines), flatfish, lobsters, *Cancer* crabs, and starfish.

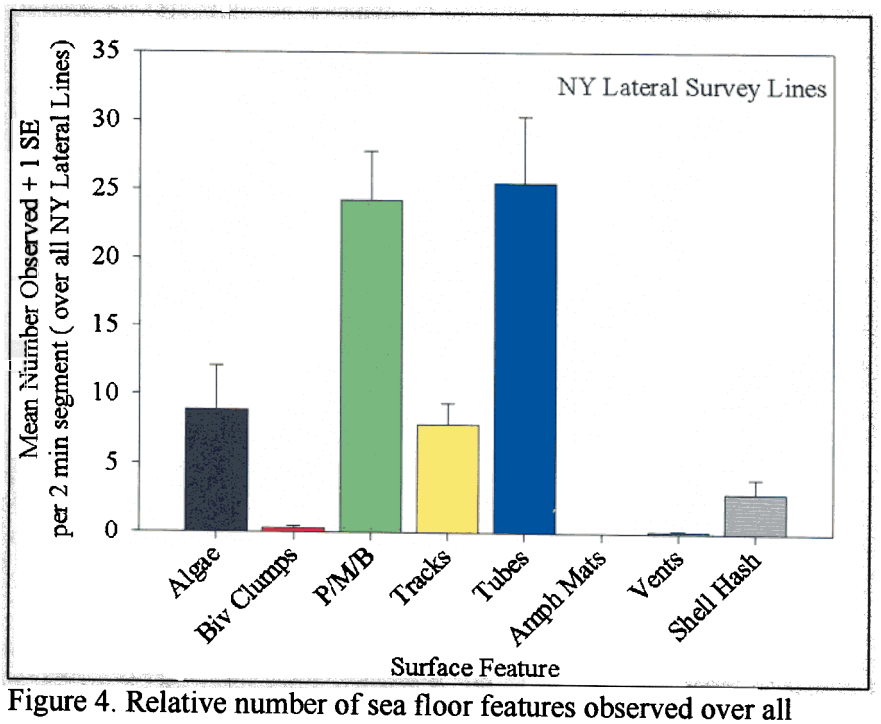


Figure 4. Relative number of sea floor features observed over all NY(north shore Long Island) lateral survey lines.